

# **COOPERATIVE RABIES MANAGEMENT PROGRAM NATIONAL REPORT 2002**



**United States Department of Agriculture  
Animal and Plant Health Inspection Service  
Wildlife Services**

# **COOPERATIVE RABIES MANAGEMENT PROGRAM NATIONAL REPORT 2002**

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## EXECUTIVE SUMMARY

In Fiscal Year (FY) 2002 the United States Department of Agriculture, Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) cooperated in oral rabies vaccination (ORV) projects targeting rabies in coyotes (*Canis latrans*) and gray foxes (*Urocyon cinereoargenteus*) in Texas (Figure 1). In the eastern United States, the program participated in a 10-state coordinated ORV project targeting rabies in raccoons (*Procyon lotor*) (Figure 1). In the Northeast, these efforts also included coordination with Provincial governments in Ontario and Quebec, Canada to ensure effective field delivery of ORV. In addition, WS cooperated in smaller, independent projects in Anne Arundel County, Maryland; Pinellas County, Florida; and on the Cape Cod isthmus, Massachusetts (Figure 1).

Wildlife Services continues to assume an important cooperative role with the Texas Department of Health and several other agencies and organizations in ORV efforts that began in 1995. Since 2000, this program has consisted of maintaining a 40-mile wide barrier in south Texas along the Rio Grande River to prevent the canine strain of rabies from re-emerging from Mexico. A single case of canine strain was confirmed within the southern portion of the vaccination zone near Laredo in 2001, underscoring the importance of continuing this preventative ORV management measure. No cases were reported in 2002. The maintenance barrier was the same in FY 2002 since it was established in FY 2000, covering more than 30,080 km<sup>2</sup> (11,000 mi<sup>2</sup>) with approximately 700,000 vaccine-laden baits. In addition, WS is an important funding and operational partner with the Texas Department of Health in ORV efforts to contain a unique gray fox variant of the rabies virus in west-central Texas. Access to Commodity Credit Corporation (CCC) funds has facilitated greater WS participation to restore this important ORV effort. In 2002, WS contributed 1.3 million baits and assisted with the distribution of 1.9 million baits over approximately 55,167 km<sup>2</sup> (21,000 mi<sup>2</sup>) to contain gray fox rabies control in Texas. Wildlife Services also fills a critical cooperative niche by providing expertise, infrastructure, and equipment to help obtain the requisite coyote and gray fox samples to continue to monitor and evaluate the status of these ORV programs.

An increase in appropriated funding and access to CCC funds allowed WS and its cooperators to extend the Appalachian Ridge ORV project as planned from southern West Virginia to northeast Tennessee during 2002. The Appalachian Ridge barrier now extends from Lake Erie in Ohio and Pennsylvania south through West Virginia and Western Virginia, to northeastern Tennessee, where it articulates with the high mountainous habitats not known to support robust raccoon populations (Figure 1). The vaccination zone covers approximately 63,298 km<sup>2</sup> (24,000 mi<sup>2</sup>) and was treated with approximately 4.3 million vaccine-laden baits in 2002. Completing this ORV step sets the stage for implementing the plan for extending the ORV zone south again in 2003, to include northeast Alabama at the southern terminus of the Appalachian Ridge.

Enhanced surveillance is in place in Alabama, northeast Georgia, and Southeast Tennessee. The purpose of this cooperative surveillance effort is to delineate the leading edge of the raccoon rabies front to be prepared to effectively implement ORV. The Centers for Disease Control and Prevention (CDC), Rabies Section, plays a pivotal role in enhanced rabies surveillance through training WS field biologists and technicians in sample collection and submission, timely laboratory diagnosis of enhanced rabies surveillance samples, serological

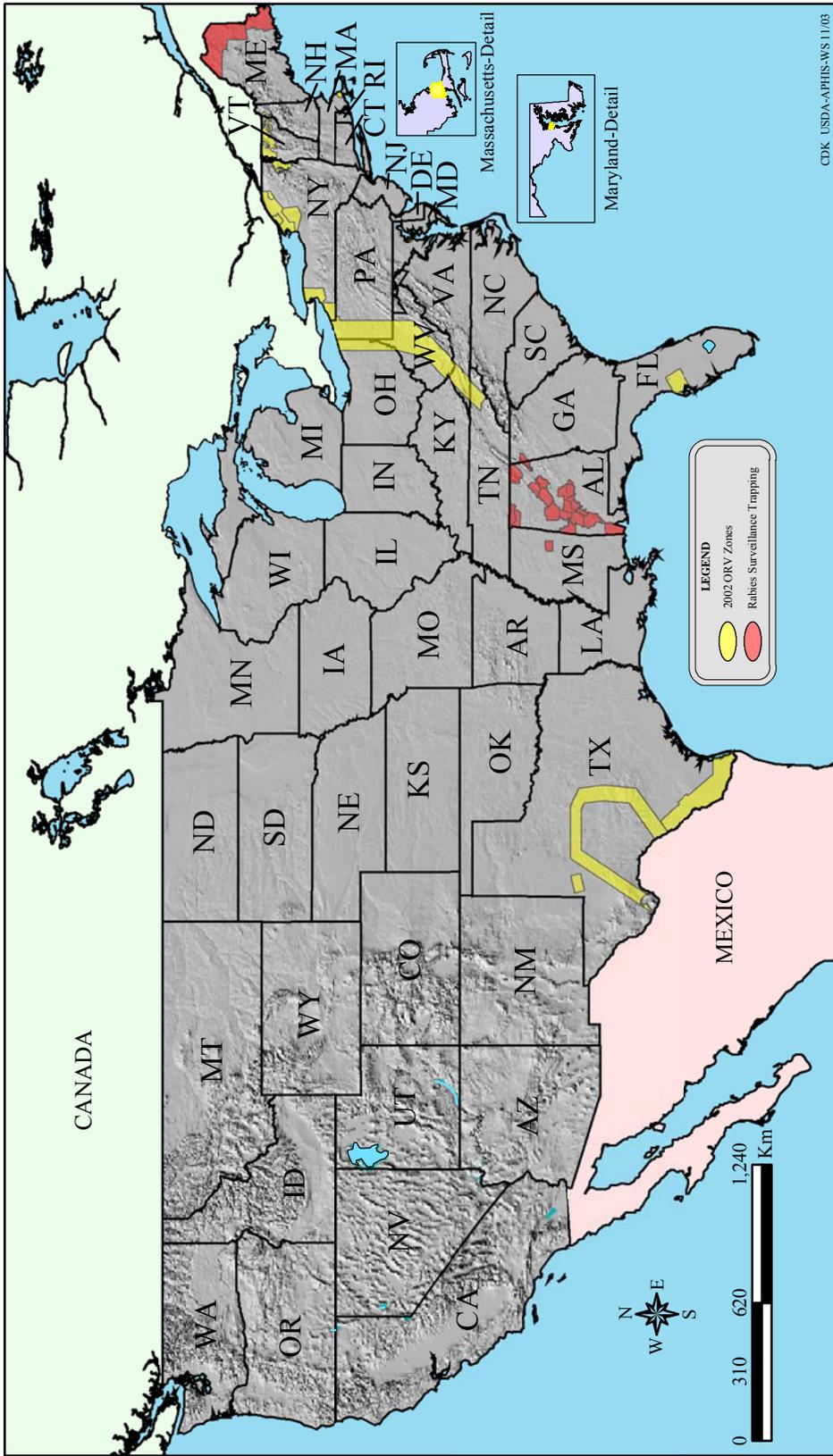


Figure 1. Cooperative Rabies Management Program ORV bait zones and rabies surveillance trapping efforts in the United States, 2002.

analysis, and expertise on rabies. The Virginia Division of Consolidated Laboratory Services (Rabies Laboratory) also provides rabies diagnostic support for enhanced rabies surveillance efforts.

In the Northeast, WS continued to work closely with Cornell University and cooperating state agencies in ORV along the Quebec, Canada border from the Connecticut River Valley in northern New Hampshire/northeastern Vermont to the St. Lawrence Valley in northern New York. This ORV area comprises over 16,298 km<sup>2</sup> (6,200 mi<sup>2</sup>), interspersed with high mountain habitat, and was treated with approximately 1.5 million baits in 2002. An important part of this effort is a study conducted by Cornell University comparing the performance of the coated sachet to fishmeal polymer baits for delivering oral rabies vaccine in the wild (Figure 2). Wildlife Services also participated in ORV activities led by Cornell University on the Niagara Frontier and in Chautauqua County, New York, which links vaccination zones along the south shore of Lake Erie from New York to Ohio. These projects required close field coordination with our Canadian counterparts in Ontario and Quebec. The New York State Department of Health Rabies Laboratory provides timely rabies diagnostic support and serological analysis.

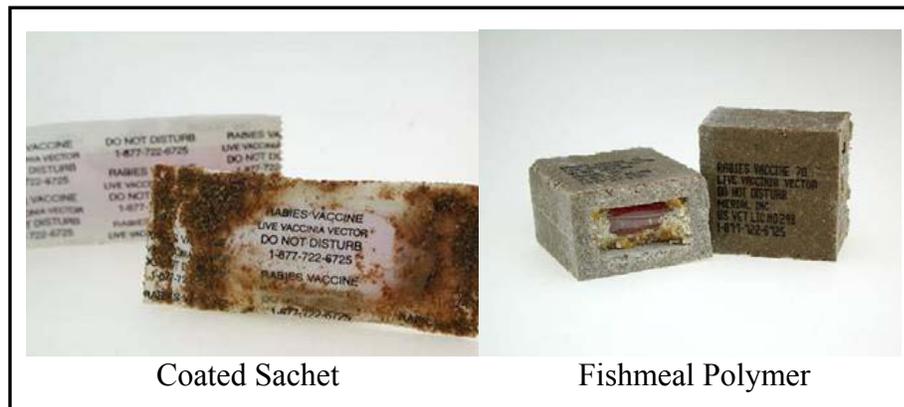


Figure 2. Coated sachet and fishmeal polymer baits utilized during the National ORV program, 2002. (Photos used with permission from MERIAL Limited, Athens, Georgia, USA).

Wildlife Services participated in cooperative ORV projects in Massachusetts, Maryland and Florida. While not immediately tied to the larger interstate ORV efforts, these continuing projects have had a successful history which provides valuable information on ORV strategies.

Research projects have been initiated at the WS, National Wildlife Research Center. A bait density study began in Pennsylvania to determine raccoon population responses to bait densities ranging from 75 to 300 baits/km<sup>2</sup>. In addition, a raccoon zoogeography study was initiated at Penn State University, which includes determining raccoon movements in the ridge and valley physiographic province. Wildlife Services began skunk placebo baiting studies in several western states. Other research efforts are in the initiation or planning stages, including studies on biomarker, maternal immunity in raccoons, and *Vaccinia* safety.

The Wildlife Services Rabies Management Team, composed of WS and other APHIS personnel, as well as expertise from other federal and state agencies, and universities, remains a critical component of the national ORV effort. This interdisciplinary team is broken down into 10 focus teams that discuss and provide recommendations on critical issues such as surveillance, NEPA compliance, vaccine development, baiting strategies, rabies economics, air support for baiting, ORV evaluation, communications planning, contingency action planning, and research

prioritization. Achieving national rabies control goals hinges in large part on sound input and recommendations from these teams.

In 2003, WS and cooperators will continue to focus on ensuring that adequate enhanced rabies surveillance and target species monitoring is in place to facilitate informed ORV decisions. The National Rabies Management Team will continue to provide the interdisciplinary expertise required to optimize ORV to meet national rabies management goals.

# WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM ALABAMA 2002

## BACKGROUND

Raccoon (*Procyon lotor*) rabies is thought to have entered Alabama in the late 1970's from Florida. The raccoon variant of rabies has since been detected in most counties east and south of the Coosa-Alabama river system, with a few confirmed raccoon rabies breaches of the Alabama River in Mobile County, Clarke County, Dallas County, Perry County, and Autauga County (Figure 1). Since 1970, an annual average of 44 raccoons were confirmed positive with rabies in southeast Alabama, and an average of 8,500 animal bites were investigated annually in the past 10 years by county health department environmentalists. In 2001, the Alabama Department of Public Health (ADPH) asked Wildlife Services (WS) and other cooperators to help determine the leading edge of the raccoon rabies variant in the state in hopes of developing an effective oral rabies vaccination (ORV) program.

Wildlife Services began enhanced surveillance of road-killed and trapped raccoons in 2001, near previous breaches in counties west of the Coosa and Alabama Rivers (Figure 1). Surveillance in 2001 and early 2002 turned up little evidence of raccoon rabies in areas near previous river breaches, indicating the river was probably the leading edge of the epizootic strain. Past cases west of the river were likely isolated events that did not result in raccoon rabies becoming established. However, in August 2002, a new breach was detected by the ADPH when a rabies-positive skunk (species unreported) in Cherokee County, west of the Coosa River, was typed and verified as the raccoon rabies variant. Wildlife Services intensified enhanced surveillance through road-kill surveys and trapping raccoons, within a 1-mile radius of the Cherokee County breach and broadened overall surveillance efforts state-wide.

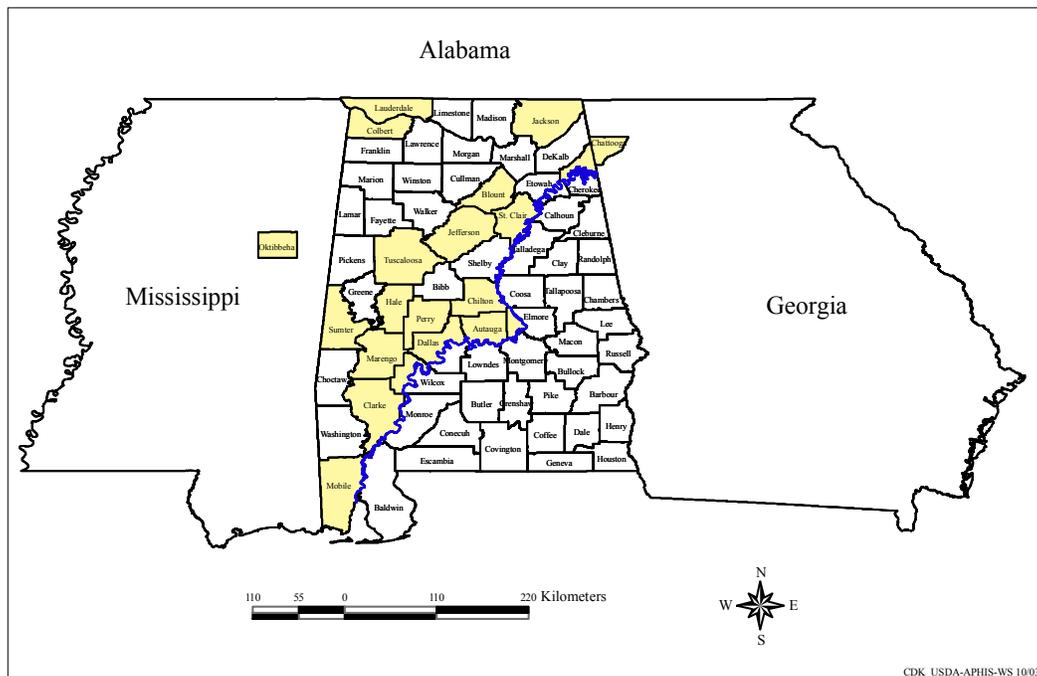


Figure 1. Counties where enhanced raccoon rabies surveillance occurred in Alabama, Georgia, and Mississippi, 2002.

## **ORV PROGRAM 2002**

In 2002, WS emphasis in Alabama also was on enhanced surveillance of raccoons to detect rabies and to determine the active disease front throughout the state. The ADPH and WS recruited support of and participation in rabies surveillance from the Alabama Department of Conservation and Natural Resources, Wildlife and Freshwater Fisheries Division, the Alabama Department of Agriculture and Industries, animal control professionals, municipal and county law enforcement officers, county rabies officers, and veterinarians along the Coosa-Alabama Rivers in 2002. Additional emphasis was placed on retrieving fresh specimens from raccoons displaying abnormal behavior, raccoons found dead in unusual places, and road-killed raccoons. Freezers and other equipment were purchased and distributed to cooperators for carcass storage, and a toll-free hotline was established in the Greensboro office for cooperator use in notifying WS personnel for carcass pick-up. Fiscal Year 2002 spending, for the Alabama ORV program (surveillance only), totaled \$362,387.

## **MONITORING, SURVEILLANCE, AND EVALUATION**

With the goal of developing effective future ORV baiting strategies in Alabama, the leading edge of the raccoon rabies front needed to be determined. Enhanced surveillance (road kill surveys and sampling) was continued in 2002 in 30 Alabama counties along the Coosa and Alabama Rivers and westward. Results from surveillance efforts yielded 3 (0.5%) confirmed cases of rabies, out of 574 brain stem samples, using direct florescent antibody (DFA) testing and 18 (3.1%) raccoons with a positive rabies antibody response (Table 1).

Surveillance also was increased in Cherokee County, Alabama, and Chattooga County, Georgia, when the ADPH reported a rabid skunk, infected with the raccoon variant of rabies, near the state borders in August 2002. This area was determined to be potentially vulnerable to raccoon rabies encroachment because of the relative lack of geographical barriers. All animals trapped in 2002 were handled according to the American Veterinary Medical Association guidelines.

## **SUMMARY**

The fall of 2002 marked the second year of WS cooperative participation in the Alabama ORV project. Work during 2001 and 2002 emphasized surveillance for evidence of raccoon rabies west and north of the Alabama and Coosa Rivers. Historically, the disease has occurred to the south and east of these rivers, with several isolated breaches of the river. Areas targeted for surveillance were near historic breaches or counties along the river. Specimens were also collected from sick animals as far west as the Mississippi/Alabama border. Support and participation from cooperators increased in 2002, as many law enforcement officers and health department environmentalists submitted specimens for testing. Results from the surveillance revealed spread from the historic front of raccoon rabies in northeast Alabama. Emphasis was then placed on active surveillance in this area to determine if the disease was moving and if it had become established.

When the leading edge of the raccoon rabies epizootic is delineated ORV baiting strategies can then be targeted more effectively to contain the spread of raccoon rabies into west

Alabama and beyond. This barrier will be tied to national ORV efforts to contain the disease and explore strategies to eliminate the raccoon variant from North America.

Table 1. Raccoons collected and tested, by county, along the Alabama-Coosa River system and westward in Alabama, Georgia, and Mississippi, 2002.

<b>County</b>	<b>DFA positive</b>	<b>Positive rabies antibody response</b>	<b>Total tested</b>
Autauga	0	2	76
Bibb	0	0	2
Blount	0	0	8
Cherokee	1	1	59
Chilton	0	0	14
Clarke	0	0	58
Colbert	0	0	2
Cullman	0	0	3
Dallas	0	2	68
Dekalb	0	0	1
Elmore	2	4	36
Etowah	0	0	46
Hale	0	1	42
Jackson	0	0	1
Jefferson	0	0	3
Lauderdale	0	0	8
Lee	0	0	1
Limestone	0	0	1
Lowndes	0	6	23
Madison	0	0	1
Marengo	0	0	3
Mobile	0	0	28
Morgan	0	0	1
Perry	0	0	24
Pickens	0	0	1
Shelby	0	0	7
St. Clair	0	0	10
Sumter	0	1	20
Tuscaloosa	0	0	4
Walker	0	0	1
Chattooga, GA	0	1	18
Oktibbeha, MS	0	0	4
<b>Total</b>	<b>3(0.5%)</b>	<b>18(3.1%)</b>	<b>574</b>



## MONITORING, SURVEILLANCE, AND EVALUATION

In an effort to address wildlife rabies in the future, WS embarked on a placebo oral rabies vaccine (ORV) bait research project. Similar research projects are being conducted by WS in California, Texas, Wyoming, and Louisiana. The goal of the research is to determine bait acceptance of a placebo ORV bait among skunks that would be ideal for future delivery of an oral vaccine efficacious in skunks. Currently this is no licensed oral vaccine that is immunogenic in skunks for use in the United States.

### Study Area

The placebo ORV bait research project began in October 2002. Two research sites were selected in southern Arizona that had similar vegetation types, comprised of plains, desert grassland, and Chihuahuan desert scrub (Brown 1994). The first site was on Ft. Huachuca Military Post and the second site was located on the Bureau of Land Managements, Las Cienegas National Conservation Management Area. The same research protocol was used on both sites.

### Methods

Three sample areas, covering 24 km of transects, were identified using the following method. An 8 km transect was placed in the center of each study area. Two additional transects were located 1 km to each side of the center transect. Placebo rabies baits (MERIAL Limited slim baits, Athens, Georgia, USA), were applied to the study areas at a density of 75 baits/km by walking or driving transects and placing a bait on the ground every 13 meters.

*Track Plots.*--Seven track plots were placed at 1 km intervals along each transect at pre-determined UTM coordinates. Track plots were placed on the travel path (e.g., game trail, livestock bed, road) most likely used by skunks. Track plots were located within a 50 m radius from the pre-determined UTM location. The specific location of each track plot was recorded with a GPS unit.

Each track plot consisted of a 2 m wide area traversing the entire travel path. All vegetation within the plot was removed and soil from the path or surrounding area was sifted over the plot to create the tracking surface. In some areas, native soil was not conducive to creating an appropriate surface, so very fine sand was sifted over the plot. Each morning, all tracks on each plot were identified and recorded and the plot was raked clean and prepared for the next track session.

Number of skunks and other animals leaving tracks within each sample area were summed daily and averaged over the number of days on which readable plots were assessed. When the track count decreased by 10% or more, from one day to the next, sampling was terminated.

*Trapping.*--One live trap was placed every 0.5 km along transects. Traps and track plots located at the same UTM coordinates were placed at least 10 m apart. Traps were located within a 50 m radius from the specified UTM coordinate in the area most suitable for capturing skunks. The specific location of every trap was recorded with a GPS unit. Traps were baited with a punctured tin of sardines in soy oil and were checked every morning.

Animals trapped after bait distribution were anesthetized with 20 mg/kg ketamine and 4 mg/kg xylazine injected intramuscularly. Blood samples were removed for rabies titer analysis

and the first premolar was extracted from the lower jaw and sent to Matson's Laboratory in Montana, to test for the presence of a tetracycline bait biomarker. All animals trapped in 2002 were handled according to the American Veterinary Medical Association guidelines.

The research project lasted 9 weeks and activities were conducted as follows:

Week 1:	Conducted track surveys
Week 2:	Distributed oral rabies vaccine
Week 3:	No research activities
Week 4:	Conducted track surveys
Week 5:	No research activities
Week 6:	No research activities
Week 7:	Conducted track surveys
Week 8:	Trapped, collected samples, and removed traps
Week 9:	Conducted track surveys

## **Results**

At the end of the project 27 skunks were captured. Sixteen of the individuals captured were hooded skunks (*Mephitis macroura*), 9 were striped skunks, and 2 were spotted skunks (*Spilogale gracilis*). Results from the teeth samples were inconclusive. The first premolar was found to be too small for reliable tetracycline analysis and conclusive results could not be reached. These findings prompted a second trapping project, which will be conducted in 2003. Information gathered from track plots and trapping was used to determine the densities of skunks at these sites. The results of this study are still pending. Non-target species captured and released included: 1 cotton rat (*Sigmodon hispidus*), 12 desert cottontail rabbits (*Sylvilagus auduboni*), 12 white-throated woodrats (*Neotoma albigula*), 1 Mexican woodrat (*Neotoma mexicana*), 1 ringtail (*Bassariscus astutus*), 1 western scrub jay (*Aphelocoma californica*), and 1 gray fox (*Urocyon cinereoargenteus*).

## **OTHER RABIES WORK**

Wildlife Services has provided direct control and technical support in Yavapai County, for control of nuisance animals and responding to potential rabies calls. We assisted Yavapai County and Prescott City Animal Control Officers in responding to potential animal rabies calls by utilizing cage traps to remove selected animals, which included raccoons (*Procyon lotor*) and skunks. Suspected rabid animals, including 1 raccoon and at least 2 skunks, were euthanized and submitted for rabies testing through the Animal Control Office. Other animals were removed included: 24 striped skunks, 4 badgers (*Taxidea taxus*), and 3 bats. None of the animals submitted tested positive for rabies.

## **SUMMARY**

Based on 2002 research project findings, WS will begin a second trapping project on the study areas in April 2003. Trapping protocol will be identical to that used in 2002, however, captured animals that will be euthanized. Blood, ear tissue, jawbone, and the head will be

collected. Lower jawbones will be removed and teeth submitted for tetracycline biomarker analysis, to determine exposure to placebo baits placed in 2002. Heads of animals will be removed and submitted for rabies diagnostics at the Arizona Department of Health Services Laboratories. All other samples collected will be sent to the WS, National Wildlife Research Center in Ft. Collins, Colorado and will be stored for possible future research.

Wildlife Services plans to conduct rabies projects for 2003 including: a placebo skunk bait study and a radio telemetry project, to track skunk movements in Flagstaff, Arizona. Also, WS will be conducting a study with feral dogs on the Navajo and Hopi Indian Reservations, to determine the most effective bait for use in an oral rabies vaccination for dogs.

It is the goal of the Arizona WS program to continue to provide support and to respond to any request for rabies surveillance and management. Wildlife Services looks forward to a strong cooperative relationship with State and local government departments, while providing federal leadership in wildlife rabies management.

### **LITERATURE CITED**

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Levy, C. 2003. Epidemiology and disease control. Vector-borne and zoonotic disease newsletter. Arizona Department of Health Services, Phoenix. March issue.

## WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM FLORIDA 2002

### BACKGROUND

Raccoon (*Procyon lotor*) rabies is enzootic throughout Florida and was first documented in the State in the 1947. Raccoon rabies was likely translocated by raccoon hunters from Florida to the mid-Atlantic states in the late 1970s, where it began to spread throughout the eastern United States as far north as southern Ontario and eastern New Brunswick, Canada. An effective raccoon oral rabies vaccination (ORV) program in Florida would constitute an important southern component in the National ORV program.

### ORV PROGRAM 2002

The objective of the Florida ORV program is to expand on the success of the Pinellas County ORV program, initiated in 1995, by establishing a vaccination zone, in areas of high human population and rabies activity, along the Interstate 4 corridor. Of the 182 confirmed cases of animal rabies in Florida in 2002, 43 cases were within the ORV zone (Table 1). The second phase of this project is to bisect the Florida peninsula with and ORV zone. The long term goal is to apply ORV throughout Florida to ultimately eliminate raccoon-strain rabies from Florida as a part of the national goal of raccoon rabies strain elimination.

Table 1. Confirmed cases of rabies, by county and species, within the Florida ORV zone, January-December, 2002 (Florida Department of Health, Bureau of Epidemiology).

County	Bat <sup>a</sup>	Bobcat <sup>b</sup>	Cat <sup>c</sup>	Dog <sup>d</sup>	Fox <sup>e</sup>	Raccoon	Total
Hernando				1		1	2
Hillsborough	1		1	1	3	6	12
Lake		1				2	3
Pasco		1			4	6	11
Polk	6		1			7	14
Sumter					1		1
<b>Total</b>	<b>7</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>8</b>	<b>22</b>	<b>43</b>

<sup>a</sup>combined by species into order *Chiroptera*

<sup>b</sup>(*Felis rufus*)

<sup>c</sup>(*Felis catus*)

<sup>d</sup>(*Canis familiaris*)

<sup>e</sup>(*Urocyon cinereoargenteus*)

In Fiscal Year 2002, the planning for the first ORV bait drop was initiated and the vaccination zone consisting of 6,293 km<sup>2</sup> (2,458 mi<sup>2</sup>) was delineated (Figure 1). The zone encompassed portions of Hernando, Hillsborough, Lake, Pasco, Polk, and Sumter counties.

Wildlife Services (WS) worked in cooperation with the Florida Department of Agriculture and Consumer Services (FDACS), Division of Animal Industry; the Florida Department of Health; the Florida Fish and Wildlife Conservation Commission; the Southwest Florida Water Management District; and the Florida Department of Environmental Service, Division of Recreation and Parks. In addition, we gained the support of many county and municipal agencies to participate in the planning and implementation for the scheduled February 2003 bait drop. Local agencies allotted approximately 2,720 man hours to the program, to

conduct ground and helicopter distribution of baits. Florida Department of Agriculture and Consumer Services was the lead state agency for the Florida ORV program.

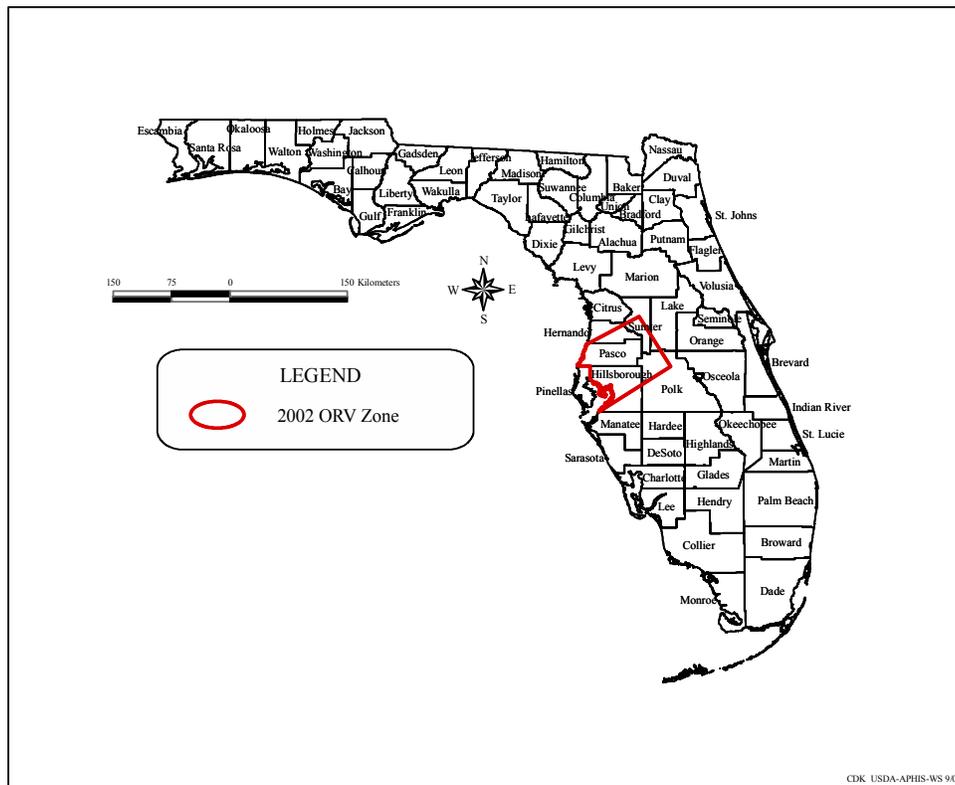


Figure 1. Oral rabies vaccination zone in Florida, 2002.

### Budget for the 2002 ORV Program

Total WS spending, for the Fiscal Year 2002 ORV program, was \$760,265 (Table 2). Additional financial support of \$100,000 was provided by FDACS.

Table 2. Wildlife Services budget for the Florida ORV program, Fiscal Year 2002.

Wildlife Services (equipment, infrastructure, travel, etc.)	\$305,350
ORV baits	\$459,915
<b>Total</b>	<b>\$760,265</b>

### MONITORING, SURVEILLANCE, AND EVALUATION

In October 2002, WS began pre-bait surveillance activities to establish baseline comparison data for tetracycline biomarker and rabies antibody titer levels, in raccoons within the ORV zone. At the conclusion of the year, 100 tooth and blood serum samples had been collected. Four of the 100 serum samples exhibited elevated titer levels. Tetracycline data are not yet available. Pre-bait trapping continued in January 2003. All animals trapped in 2002 were handled according to the American Veterinary Medical Association guidelines.

## **SUMMARY**

The summer of 2002 marked the first year of Florida's involvement in the raccoon ORV program. The focus of activities at this beginning stage was the communication with numerous state and local agencies. Emphasis was placed on public education about ORV to gain broader support at the local level. Once that goal was achieved, the focus shifted to the logistical planning for the upcoming bait drop in February 2003. Aside from coordinating with other agencies, WS conducted pre-bait surveillance trapping of raccoons to obtain tetracycline biomarker and serology background information.

## **WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM MAINE 2002**

### **BACKGROUND**

The United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (WS) conducted 2 raccoon (*Procyon lotor*) density studies in the state of Maine during August and September 2002. Surveillance is essential for determining the status of the raccoon rabies virus, which entered the state in 1994. During 2002, there were 67 positive rabies cases reported by the Maine State Health and Environmental Testing Laboratory in Augusta, Maine. Previously, in 2001, there were 85 positive cases reported involving wildlife, domestic animals, and humans, which came into contact with potentially rabid animals. In addition to the density studies, WS also initiated additional rabies surveillance, through road kill surveys, by acquiring raccoons which were tested for rabies at the Maine State Health and Environmental Laboratory.

### **ORV PROGRAM 2002**

In 2002, Maine conducted rabies surveillance of raccoon populations; no baits were distributed. During Fiscal Year 2002, \$121,804 was spent on rabies related activities in Maine.

### **MONITORING, SURVEILLANCE, AND EVALUATION**

Objectives of the raccoon density studies were to: (1) estimate relative density indices of raccoon populations at 2 sites, along the Maine/New Brunswick (NB) Canada border, (2) help assess the status of rabies in Maine, and (3) aid in assessing the effect upon human health and safety. Data collected included: estimated population densities, age and sex ratios, and health status of the populations sampled.

Methods involved in the raccoon relative density study included setting 50 live traps, throughout a 3 km<sup>2</sup> area, for 10 consecutive nights. Each trap was baited with 2 marshmallows and oil of anise. Traps were checked daily and periodically, some were moved either to better trapping locations or to ensure that the study area was evenly sampled. When a unique raccoon was captured, WS personnel anesthetized the animal, obtained a blood sample, pulled an upper #1 premolar, applied 2 ear tags, assessed general health status, and recorded sex, weight, and age. Data collected from recaptured animals included ear tag number and trap site location. Recaptured animals were released on site. All animals trapped in 2002 were handled according to the American Veterinary Medical Association guidelines.

### **Aroostook County**

Trapping was conducted from 20-30 August 2002 (Table 1). The site was located within the Lt. Gordon Manuel Wildlife Management Area, in Hodgdon, Maine and was 5 miles west of NB Canada (Figure 1). The site is characterized by agricultural, forest, and wetland habitats and was 166m above sea level. Age structure of the captured population was 10 adults and 9 juveniles, trapped throughout the study area, in various habitat types. Relative density was estimated at 6.3 raccoon/km<sup>2</sup>. Non-target species captured include, 3 snowshoe hares (*Lepus*

*americanus*), 4 striped skunks (*Mephitis mephitis*), and 1 fisher (*Martes pennanti*), which were released on site and unharmed.

Table 1. Results of raccoon surveillance trapping efforts in Aroostook and Washington Counties, Maine, 2002.

	Trapping sites	
	Aroostook County	Washington County
Trap nights	500	500
Unique raccoons	20	2
Recaptured raccoons	4	0
Total raccoons	24	2
Trap success <sup>a</sup>	4.0%	0.4%
Non-target animals	8	11

<sup>a</sup>unique raccoons

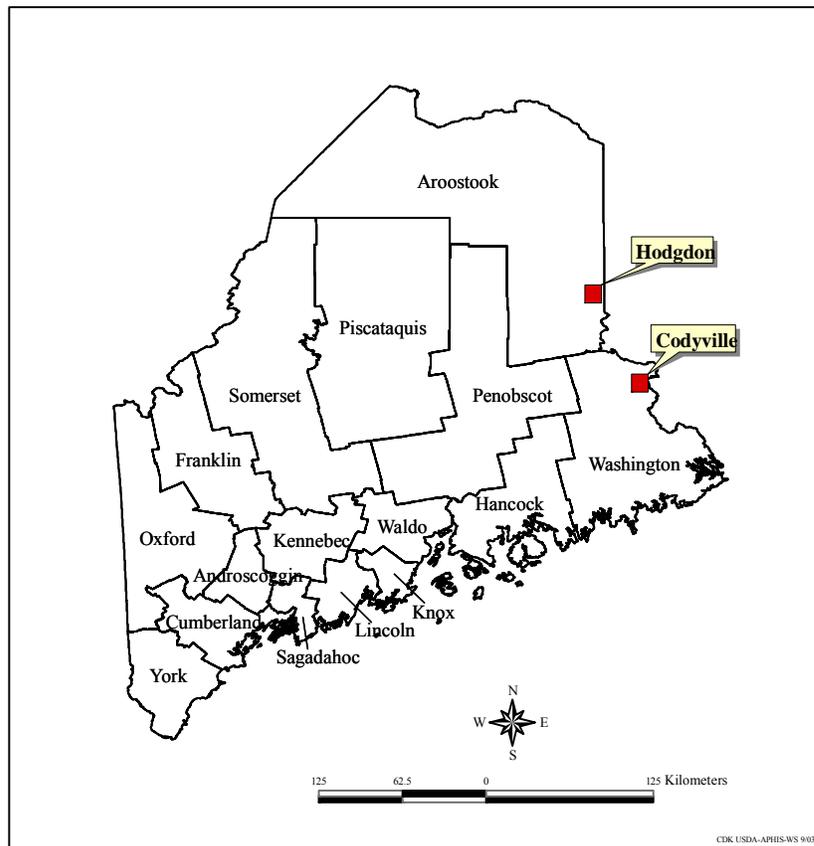


Figure 1. Location of 2 raccoon density estimation studies in Aroostook and Washington Counties Maine, 2002.

### Washington County

Trapping was conducted from 10-20 September 2002 (Table 1). The site was located in Codyville, Maine and was 12 miles from NB Canada (Figure 1). The site is characterized primarily by commercial forest land, along with wetlands and was 66m above sea level. Age structure of the captured population was 1 adult and 1 juvenile. Relative density was estimated at 1 raccoon/km<sup>2</sup>. Non-target species captured included 11 snowshoe hares, which were released onsite and unharmed.

## **SUMMARY**

The results of the 2002 density studies provided a sound estimate for raccoons in unsuitable habitat. This type of data is important to help refine ORV strategies in the future in areas with similar habitats.

Goals for the 2003 rabies program are to increase enhanced rabies surveillance, continue raccoon relative density studies, and participate in the first ORV effort in Maine in the St. Croix River Valley along the NB Canada border.

## **WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM MARYLAND 2002**

### **BACKGROUND**

Raccoon (*Procyon lotor*) rabies first entered Maryland in Allegany County in 1981. It quickly spread and is now present throughout the state. Raccoon rabies was first documented in Anne Arundel County in 1984. In 2000, Anne Arundel County reported 43 cases of animal rabies, a downward trend from the 73 reported in 1998 and 97 cases in 1997. From 1996-1998 an average of 18 cases of animal rabies was reported from the Annapolis Peninsula alone. In October 1998, the Anne Arundel County Department of Health initiated an oral rabies vaccination (ORV) program on the Annapolis Peninsula. Baits, containing Raboral V-RG® vaccine (MERIAL Limited, Athens, Georgia, USA), have been distributed each year on the Annapolis Peninsula since October 1998 and on Gibson Island since 2000. In 2001, the ORV program was expanded with the assistance of USDA, APHIS, Wildlife Services (WS) to the Broadneck Peninsula, Anne Arundel County. Annapolis Peninsula, Gibson Island, and Broadneck Peninsula comprise 94 km<sup>2</sup>, 4 km<sup>2</sup>, and 88 km<sup>2</sup>, respectively. This is a cooperative effort between WS and the Anne Arundel County Department of Health. Wildlife Services provides the major source of funds for project implementation.

### **ORV PROGRAM 2002**

The 2002 ORV efforts targeted the same areas of Anne Arundel County, Maryland as in 2001 (the Annapolis Peninsula, the Broadneck Peninsula, and Gibson Island) (Figure 1). Fishmeal polymer baits, containing Raboral V-RG® vaccine, were distributed by helicopter and ground teams on Annapolis and Broadneck Peninsulas from 9-13 September and on Gibson Island by 27 August. On the Annapolis Peninsula, 9,358 baits were distributed by helicopter and 75 baits by hand; on Broadneck Peninsula, 5,501 baits were distributed by helicopter and 1,946 baits by hand; on Gibson Island, 400 baits were distributed by hand. The cost for each bait was \$1.27. Aircraft and flight crew for the 2002 ORV program were provided at no cost by the Anne Arundel County Police Department. Baiting efforts and support were provided by WS and the Anne Arundel County Department of Health. Fiscal Year 2002 spending, on rabies activities, totaled \$129,711.

### **MONITORING, SURVEILLANCE, AND EVALUATION**

#### **Annapolis Peninsula, Broadneck Peninsula, and Gibson Island Studies**

The goal of the ORV program is to achieve sufficient levels of immunity in the raccoon population to reduce the number of people and pets exposed to rabid animals and to eventually eliminate the raccoon strain of rabies. Since 2001, WS has cooperated with the Anne Arundel County Department of Health in a multi-year study to assess aerial ORV baiting efficacy on 2 peninsulas and 1 island in Anne Arundel County.

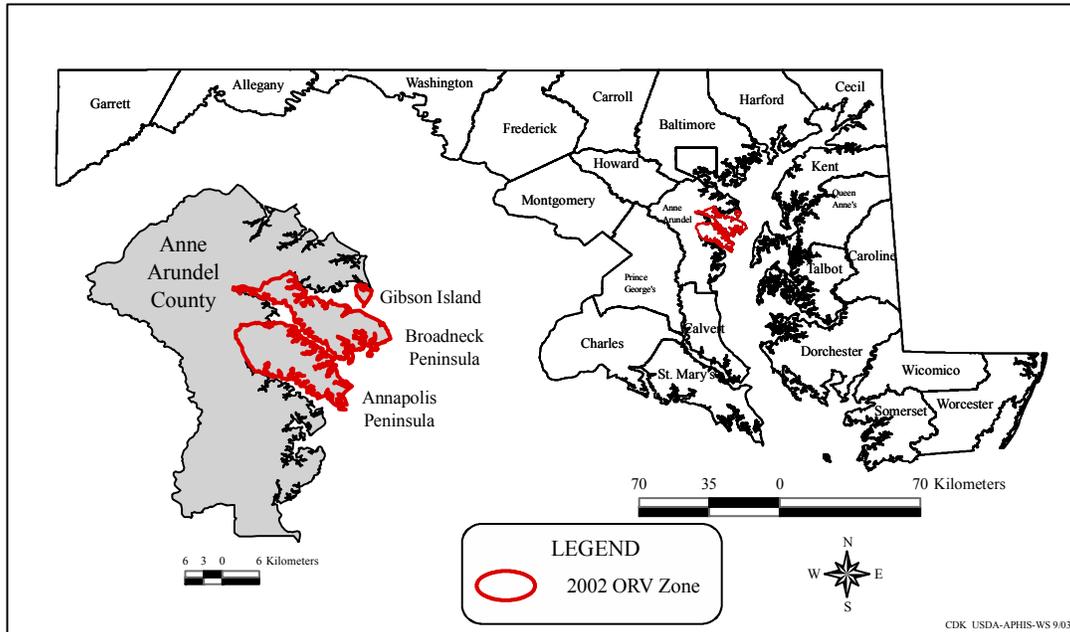


Figure 1. Oral rabies vaccination zone in Anne Arundel County, Maryland, 2002.

On 23 September 2002, 15 October 2002, and 4 November 2002, WS initiated post-ORV raccoon live trapping to collect blood serum as well as other biological data to evaluate and monitor project success on the Annapolis Peninsula, the Broadneck Peninsula, and Gibson Island (Table 1). All animals trapped in 2002 were handled according to the American Veterinary Medical Association guidelines.

Table 1. Post-bait ORV surveillance efforts on the Annapolis Peninsula, Broadneck Peninsula, and Gibson Island, Anne Arundel County, Maryland, 2002.

	<b>Annapolis Peninsula</b>	<b>Broadneck Peninsula</b>	<b>Gibson Island</b>
Trap nights	318	458	122
Unique raccoons	52	55	38
Recaptured raccoons	2	9	2
Total raccoons	54	64	40
Trap success <sup>a</sup>	16.4%	12.0%	31.1%
RVNA <sup>b</sup> positive	46.0%	36.0%	18.0%

<sup>a</sup>unique raccoons

<sup>b</sup>rabies virus neutralizing antibodies

### Other ORV Surveillance

In June 2002, at the request of the Anne Arundel County Department of Health, WS conducted ORV raccoon live trapping to collect biological samples from an area immediately beyond the southern boundary (South River) of the Annapolis Peninsula ORV area (Figure 1). Samples were collected from 57 raccoons over 329 trap nights (Table 2).

Sixty six non-target animals were captured and released in 2002, they included: 23 feral cats (*Felis catus*), 1 red fox (*Vulpes vulpes*), 1 gray fox (*Urocyon cinereoargenteus*), 30

opossums (*Didelphis virginiana*), 2 Eastern cottontail rabbits (*Sylvilagus floridanus*), 1 gray squirrel (*Sciurus carolinensis*), 3 Eastern box turtles (*Terrapene carolina*), 2 striped skunks (*Mephitis mephitis*), and 3 woodchucks (*Marmota monax*).

Table 2. Oral rabies vaccination surveillance efforts in the South River study area of Anne Arundel County, Maryland, 2002.

	<b>South River</b>
Trap nights	329
Unique raccoons	58
Recaptured raccoons	8
Total raccoons	66
Trap success <sup>a</sup>	17.6%
RVNA <sup>b</sup> positive	7.0%

<sup>a</sup>unique raccoons

<sup>b</sup>rabies virus neutralizing antibodies

Levels of rabies virus neutralizing antibodies, in pre- and post-ORV live-trapped raccoons, will be used to help determine the effectiveness of current baiting in the 3 ORV zones in Anne Arundel County. The location of recaptures also will aid in determining home range and size/movement patterns of the raccoons in the study areas.

## **SUMMARY**

The summer of 2002 marked the second year of WS' cooperative participation in the Anne Arundel County Department of Health ORV Project for the Annapolis and Broadneck Peninsulas and Gibson Island. In 2003, with the assistance of WS, the Anne Arundel County Department of Health ORV Project may expand ORV efforts to include all areas of Anne Arundel County.

To date 63,130 Raboral V-RG® baits have been distributed across three ORV zones in Anne Arundel County, encompassing a 186 km<sup>2</sup> area (72 mi<sup>2</sup>). During the 3 years prior to this project, in October 1998, an average of 18 rabid animals were reported from the Annapolis Peninsula. Since the program was initiated in 1998, only 1 rabid raccoon was reported from the Annapolis Peninsula during 1999, and none were reported from 2000-2002.

## **WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM MASSACHUSETTS 2002**

### **BACKGROUND**

In 1992, terrestrial wildlife rabies (raccoon strain) was first detected in a northern Massachusetts town and subsequently spread to all counties except Barnstable (Cape Cod), Dukes (Martha's Vineyard), and Nantucket (Nantucket Island) Counties (Figure 1). Between 1992 and 2002, 2,136 raccoons (*Procyon lotor*) and 1,195 striped skunks (*Mephitis mephitis*) tested positive for rabies. A potentially important development is that annual rabies prevalence in skunks has exceeded the annual prevalence in raccoons in some years (e.g., in 2002, 141 skunks tested positive versus 85 positive raccoons). This trend also has been noted in the neighboring state of Rhode Island. Studies to address the questions of strain typing and potential reporting biases are in pilot stages. The Massachusetts Department of Public Health (MDPH) continues to monitor and report on specimens collected and tested due to human or domestic animal exposure and for rabies surveillance. In 2002, 3,137 animals (wild and domestic) were submitted for testing, with 304 testing positive. Reactions to several high profile conflicts between carnivores and humans highlighted the level of fear Massachusetts residents have about rabies.

### **Highlights**

In 2002, the United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service, Wildlife Services (WS) continued to provide support the Cape Cod Oral Rabies Vaccination (CCORV) program in southeastern Massachusetts. This is a cooperative effort (1994-present) among Tufts University (TU), MDPH, Barnstable County Department of Health and the Environment, and WS, designed to reduce the incidence of terrestrial rabies in a 420 km<sup>2</sup> area directly adjacent to the Cape Cod Canal (Figure 1). It also is designed to prevent the spread of rabies to Cape Cod, a heavily populated tourist destination south of Boston. Full-time assistance from WS began in 2001 and has typically included bait acquisition and distribution, membership on the Massachusetts State and Barnstable County Rabies Advisory Committees, rabies surveillance trapping, and small-scale studies to examine raccoon and skunk population attributes and the applicability of population indexing methods.

Other 2002 WS activities, related to the cooperative ORV program, included implementation of an investigation of the potential utility of 2 types of track stations for assessing relative raccoon/skunk/other carnivore abundance and distribution to support oral rabies vaccination (ORV) decisions in southeastern Massachusetts and assisting with the development of a contingency plan for a potential epizootic of terrestrial rabies on Cape Cod.

### **ORV PROGRAM 2002**

In 2002, WS assisted TU with hand-baiting distribution of 36,472 fishmeal polymer ORV baits, containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA), during several baiting episodes over the 420 km<sup>2</sup> CCORV area (Table 1). In addition, WS assisted TU with emergency distribution of 2,160 ORV baits in November on peninsular Cape Cod (primarily at bridges), in response to rabies positive cases detected at the eastern edge of the CCORV

treatment area (Table 1). Fiscal Year 2002 spending, on rabies activities and research, totaled \$124,910.

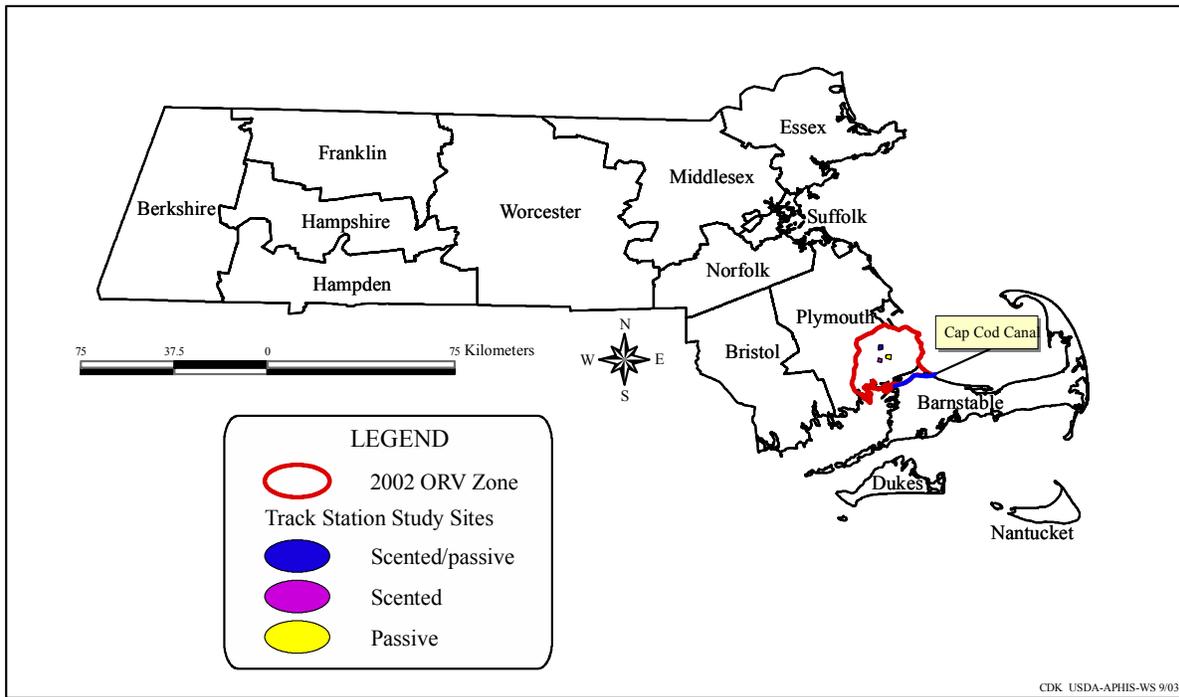


Figure 1. Oral rabies vaccination treatment area in southeastern Massachusetts, 2002.

Table 1. Cape Cod Oral Rabies Vaccination Program bait distribution, southeastern Massachusetts, 2002.

Month	Baits distributed	Area baited (km <sup>2</sup> )	Baits/km <sup>2</sup>
May	15,310	150	102
September	15,542	245	63
October	4,566	110	42
October	1,054	100	11
November	2,160	31	70
<b>Total</b>	<b>38,632</b>		

## MONITORING, SURVEILLANCE, AND EVALUATION

### Surveillance Trapping

During June-July 2002, WS assisted TU with post-ORV surveillance trapping. Blood serum samples, age, sex, reproductive condition, and weight were collected from raccoons (94 unique and 14 recaptured) and 10 striped skunks (Table 2). In addition, WS conducted additional surveillance trapping late in the year, during which 15 unique and 5 recaptured raccoons and 1 skunk samples were collected (Table 2). Non-target animals captured and released included: 12 striped skunks, 1 gray fox (*Urocyon cinereoargenteus*), and 1 red fox (*Vulpes vulpes*). All animals trapped in 2002 were handled according to the American Veterinary Medical Association guidelines.

Table 2. Raccoon surveillance trapping age/sex structure data<sup>a</sup> for the CCORV program, southeastern Massachusetts, 2002.

	<b>Adult (n<sup>b</sup>/%)</b>	<b>Subadult/YOY<sup>c</sup> (n/%)</b>	<b>Unreported age (n/%)</b>
Female	22/20.1	22/20.1	1/0.9
Male	50/45.8	12/11.0	1/0.9
Unreported sex	1/0.9	0/0	

<sup>a</sup>total=109

<sup>b</sup>number

<sup>c</sup>young-of-year (<1 year of age)

## Road Kill Surveillance

In 2002, WS collected 26 raccoons and 21 skunks from Massachusetts roads for rabies and vaccination surveillance specimens. Mandibles or teeth were removed for aging and tetracycline biomarker detection, and specimens were sexed, weighed, assessed for reproductive status, and screened for rabies lab-quality. Those with intact craniums, that were not badly decomposed, were frozen for submission to the MDPH, Laboratory Institute. Road-killed specimens were also collected by TU.

## DEVELOPING METHODS

### Population Assessment

Pitch pine (*Pinus rigida*)/scrub oak (*Quercus ilicifolia*) communities dominate much of the current CCORV zone and the area under ORV treatment (peninsular Cape Cod) (Figure 1). To build upon 2001 WS density estimation work, we initiated a long-term, track-based, relative density index study in 2002 to further assess raccoon use of this habitat type and to test passive and scented track station effectiveness (Figure 2). Results of this study could increase cost effectiveness of ORV programs through reduced bait densities in this habitat type in Massachusetts and elsewhere.

## COOPERATORS

Major CCORV cooperators, other than WS, provide logistical support, planning/direction, funding, or facilities. They include:

- TU, School of Veterinary Medicine
- MDPH
- Barnstable County Department of Health and the Environment
- Massachusetts Division of Fisheries and Wildlife
- Massachusetts Department of Food and Agriculture
- Massachusetts State Police Air Wing
- Massachusetts Metropolitan District Commission
- Senior Environmental Corps

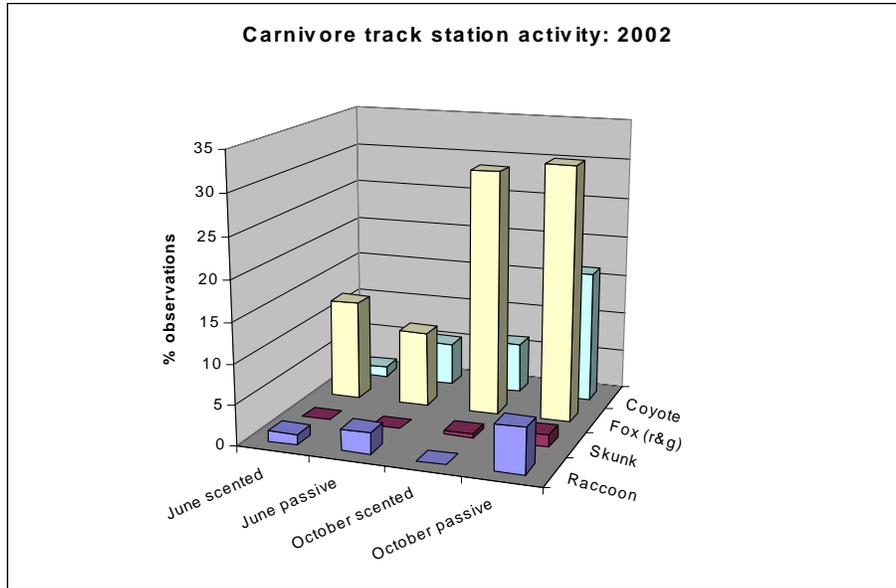


Figure 2. Carnivore track station activity, southeastern Massachusetts, 2002. June scented (n=72) and passive (n=74) and October scented (n=174) and passive (n=195).

### 2003 PROJECT/WORK PLANS

Upcoming events and potential program changes include:

- Bait distribution strategy changes, based on review of historical baiting strategies and rabies surveillance data.
- Wildlife Services accepting responsibility for bait distribution efforts, including volunteer and cooperator organization and helicopter assistance from the Massachusetts State Police for aerial bait distribution.
- In-house compilation of all capture and serology data, from WS efforts.
- An agreement between WS and the MDPH, Laboratory Institute for testing rabies surveillance specimens.
- An active role for WS in contingency planning for Massachusetts rabies control efforts.
- Wildlife Services response to significant State and TU budget cuts, to continue the CCORV program and to continue meeting research needs of potential national significance.
- Continuation of the track-based, relative density index study.
- Wildlife Services providing logistical support and training to 2 TU students, with outside grants for raccoon research.

## **WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM NEW HAMPSHIRE 2002**

### **BACKGROUND**

The first case of raccoon (*Procyon lotor*) rabies confirmed in New Hampshire was a bit of an anomaly. In March 1992, a raccoon entered a local police officer's house in Rumney and began fighting with the family Doberman. The officer was forced to shoot the raccoon under the kitchen table. The raccoon, likely to be a "pet" of unknown origin, was brought to a local veterinarian's office and was found wearing two flea collars. Rumney is approximately 128 km (80 miles) north of the New Hampshire-Massachusetts state borders and officials believed the family caring for the raccoon translocated it from a rabies-infected area in southern New England. Fortunately, no additional cases were detected in that area, but raccoon rabies did enter New Hampshire in the fall of 1992 as an extension of the epizootic in southern New England. Once in new Hampshire, rabies continued its northward spread at a rate of about 40 km (25 miles) a year. Raccoon rabies has been confirmed in all 10 counties, with the northernmost case occurring in Lancaster approximately 64 km (40 miles) south of the United States-Canada border.

Just months after the Lancaster, New Hampshire case was documented, a rabid raccoon was confirmed in Lunenburg, Vermont immediately across the Connecticut River (state border) from Lancaster. This prompted concern over the spread of rabies through the Connecticut River Valley in northern New Hampshire and Vermont into Canada. In August 2001, an oral rabies vaccination (ORV) program was initiated in New Hampshire. The goal was to prevent the northward spread of the raccoon variant of the rabies virus. Through aerial and hand bait distribution, 17,690 fishmeal polymer (FMP) baits, containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA), were distributed in the summer of 2001 over a 385 km<sup>2</sup> (149 mi<sup>2</sup>) area. In August of 2002, the same area was baited with 18,140 fishmeal-coated sachet (CS) baits.

The New Hampshire ORV program has been a cooperative effort, with Cornell University; Wildlife Services (WS) has been the major source of federal funds for project implementation. Wildlife Services also has provided federal wildlife management leadership, by continuing to play an active role in: planning and project coordination; organizing ground support for the bait drop; working in and navigating aircraft to distribute baits; coordinating the hand distribution of baits in areas too populated to bait by air; and providing surveillance and follow-up field work; collecting blood and tooth samples from live-trapped animals; and collecting samples from suspect-rabid animals within the New Hampshire ORV bait zone.

### **ORV PROGRAM 2002**

In 2002, New Hampshire baiting activities took place in conjunction with the Vermont ORV bait drop. Baiting required one flight during which 18,140 CS baits were distributed by Twin Otter fixed-wing aircraft on 25 August; 140 FMP baits were also distributed by hand in the village of Colebrook, New Hampshire on 26 August (Figure 1). Aircraft and flight crew for the 2002 ORV bait drop were provided by the Ontario Ministry of Natural Resources, while ground and baiting support was provided by WS, Cornell University, and the Vermont Department of Health.

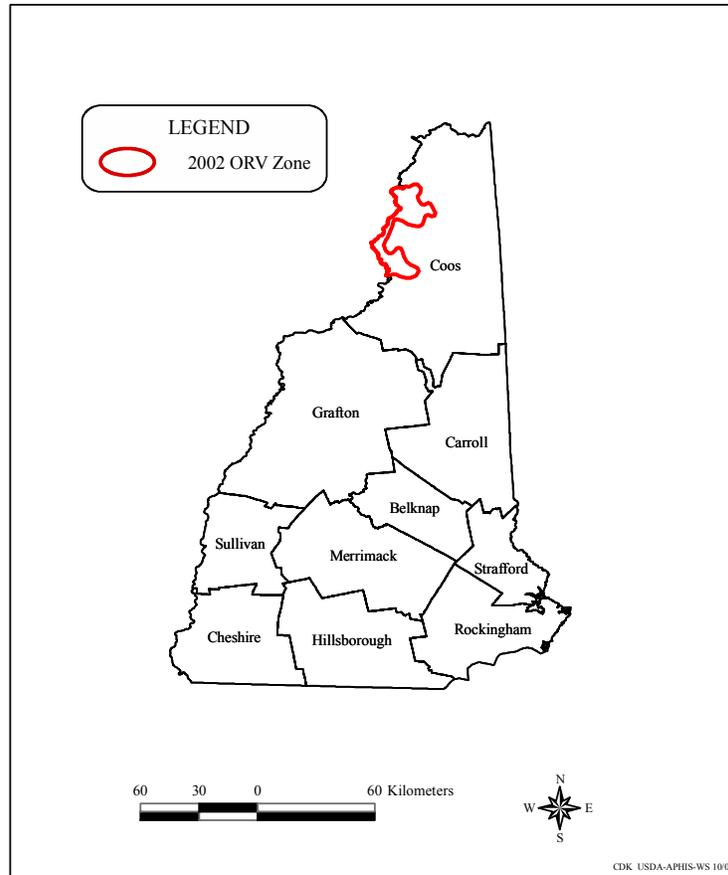


Figure 1. Oral rabies vaccination zone in northern New Hampshire, 2002.

## MONITORING, SURVEILLANCE, AND EVALUATION

In an effort to establish population trends in areas of common agricultural habitat and to evaluate the effectiveness of the ORV program, WS conducted raccoon relative density studies in Stratford, New Hampshire on the same site in July 2001 and July 2002. Studies were conducted using an established protocol of 50 traps over 10 consecutive nights (500 trap nights) on 1 3-km<sup>2</sup> study site. Approximate elevation at the study site was 310 meters (1,000 feet). Seven (1.4% trap success) and 5 (1.0% trap success) unique raccoons were captured in 2001 and 2002, respectively. Relative density was estimated to be 2.3 raccoons/km<sup>2</sup> and 1.7 raccoons/km<sup>2</sup> in 2001 and 2002, respectively. Relative density estimates were lower than expected in the study area, which is located in the upper Connecticut River Valley. Wildlife Services also collected blood and tooth samples from each raccoon during both studies. Results will be used to help assess bait uptake and immune status of the localized raccoon populations at the study site for each year.

Non-target animals captured and released in 2002 included: 1 feral cat (*Felis catus*), 1 gray squirrel (*Sciurus carolinensis*), 1 snowshoe hare (*Lepus americanus*), 5 striped skunks (*Mephitis mephitis*), and 1 woodchuck (*Marmota monax*). All animals trapped in 2001 and 2002 were handled according to the American Veterinary Medical Association guidelines.

## **SUMMARY**

The summer of 2002 marked the second year of WS cooperative participation in the New Hampshire ORV program. The New Hampshire program is an integral part of a larger Northeastern cooperative effort (that in 2002 included New York, Vermont, Maine, and Quebec and Ontario, Canada), which in turn, is an integral part of national ORV efforts to contain the raccoon strain and explore strategies to eliminate this unique variant of the rabies virus.

# WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM NEW YORK 2002

## BACKGROUND

Raccoon (*Procyon lotor*) rabies first entered New York in 1990. The disease quickly spread and now is present throughout the state, except for Franklin County, the Adirondack Mountains, and parts of Long Island. Raccoon rabies was first documented in St. Lawrence County in 1997. An epizootic outbreak occurred in 1998, with 148 confirmed wildlife cases. The outbreak continued to spread in 1999, resulting in 139 cases. Following an epizootic in 1998, an intensive oral rabies vaccination (ORV) program was initiated in St. Lawrence County in an attempt to prevent further northward spread of the disease through New York and into Canada.

The ORV program in northern New York includes all of Jefferson County, northern portions of St. Lawrence, Oswego and Lewis Counties, and the western portion of Franklin County. The current bait zone comprises 12,618 km<sup>2</sup>. This season marks the first year that the bait zone was expanded into Oswego and Lewis counties, an increase of approximately 3,000 km<sup>2</sup>, when compared to the 2001 bait zone. The bait zone is bounded by the St. Lawrence River to the North, Lake Ontario to the West, the Tug Hill Plateau to the South, and the Adirondack Mountains to the East. Additionally, 6,919 km<sup>2</sup> were baited in Niagara, Erie, and Chautauqua Counties in western New York (Figure 1). Cornell University is the lead coordinating agency for this project, with Wildlife Services (WS) as an active participant, providing major cooperative funding and federal wildlife management leadership.

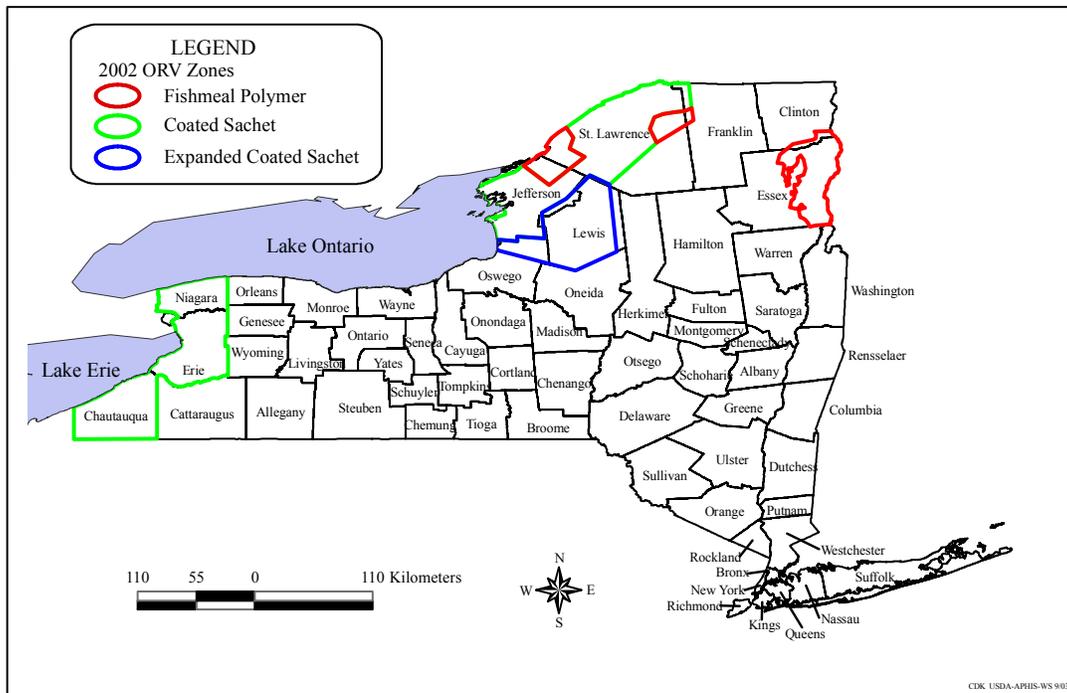


Figure 1. Oral rabies vaccination zone in the St. Lawrence Region, Champlain Valley, and western New York, 2002.

## ORV PROGRAM 2002

Aerial baiting in the St. Lawrence Region occurred from 26-31 August 2002. Two types of baits, containing Raboral V-RG® vaccine (MERIAL Limited, Athens, Georgia, USA), were distributed as part of the 2002 ORV program. In the St. Lawrence Region, 779,220 coated sachet (CS) baits and 126,681 fishmeal polymer (FM) baits were distributed. In western New York, 393,600 CS baits and 87,101 FM baits were distributed between 1-2 September 2003 and between 30 September-5 October 2002. Coated sachet and FM baits cost \$1.00/bait and \$1.27/bait, respectively. Aircraft and flight crew for the 2002 ORV program were provided by the Ontario Ministry of Natural Resources (OMNR). Ground and baiting support was provided by WS, Cornell University, and the St. Lawrence County Health Department. Fiscal Year 2002 spending, on rabies activities and population monitoring and movement studies, totaled \$1,254,215. Of this total, bait purchases accounted for \$750,000.

Wildlife Services staff also cooperated with the New York State Department of Health Zoonoses Program to purchase and distribute close to 130,000 ORV baits for distribution in Clinton and Essex Counties, New York. In addition, 4 WS Biologists assisted the State in monitoring the Champlain Valley ORV project by trapping raccoons in the ORV zone to collect blood and tooth samples in September 2002.

## MONITORING, SURVEILLANCE, AND EVALUATION

### St. Lawrence Region

The goal of the ORV program is to achieve sufficient levels of immunity in the raccoon population to create a barrier against the spread of the rabies virus into new, uninfected areas. On 30 September 2002, WS initiated post-ORV live trapping to collect blood serum and tooth samples, as well as other biological data, to evaluate and monitor project success (Table 1). All animals trapped in 2002 were handled according to the American Veterinary Medical Association guidelines.

Table 1. Raccoon surveillance trapping efforts for the ORV project in the St. Lawrence Region of New York, 2002.

	Bait type	
	Coated sachet	Fishmeal polymer
Trap nights	758	543
Unique raccoons	94	100
Recaptured raccoons	9	15
Total raccoons	103	115
Trap success <sup>a</sup>	12.4%	18.4%
Mean elevation	100m	125m

<sup>a</sup>unique raccoons

Raccoon rabies has spread to new areas, at approximately 18-24 km/year, since the disease became established in the Mid-Atlantic region in the late 1970s. Raccoon rabies appears to spread most rapidly in preferred raccoon habitats supporting higher raccoon densities (Table 2), while major physiographic barriers, such as rivers and mountain ranges, appear to impede the spread of rabies. The St. Lawrence River may act as a physical barrier, impeding the northward movement of rabies. In addition, high mountain elevations with contiguous forest, such as those

in the Adirondack and Appalachian Mountains, may support low raccoon densities and also act as barriers to the spread of the rabies virus. In a coordinated effort to monitor raccoon populations, 5 relative density studies have been completed in New York to help document raccoon population density trends. Relative densities ranged from 11 raccoon/km<sup>2</sup> in good habitats, to extremely low densities or no detectable raccoon population in poorer habitats toward the Adirondack Foothills and Mountains (Table 2).

Table 2. Estimated relative density indices (raccoon/km<sup>2</sup>) of raccoon populations in the St. Lawrence Region of New York, 1999-2001.

Year	Location	Elevation (m)	Density index
1999	Louisville (lowland)	75	9
1999	Colton (foothills)	450	2
2000	Clifton (mountains)	470	0
2000	Colton (river corridor)	450	2
2001	Hammond (lowland)	100	11

### St. Lawrence River Shoreline Study

Raccoon fidelity for developed shoreline habitat, where food is abundant, in conjunction with the inability to aerially distribute baits at prescribed densities along the shoreline, could result in a significantly under-vaccinated subset of the local raccoon population. These under-vaccinated areas may represent corridors through which raccoon rabies spread, compromising larger ORV efforts. Raccoons, ear tagged in Canada by the OMNR, have been captured in New York by WS staff on several occasions.

In 2001, WS initiated a multi-year study to assess aerial ORV baiting efficacy along the St. Lawrence River shoreline. Steep topography, numerous small islands and a highly developed shoreline typify the study area, posing challenges for distributing baits to targeted raccoon habitat. Inability to distribute sufficient numbers of baits to raccoon habitat immediately adjacent to the river may be exacerbated by flight lines that run perpendicular to the river.

Raccoons were trapped and sampled for biomarker and serology testing. Samples collected in 2001 and 2002 prior to the ORV bait drop are being compared to samples collected after the bait drop. Pre-bait drop sampling in 2002 began in June and continued through mid-August (Table 3).

Table 3. Pre-bait and post-bait drop trapping results, St. Lawrence River Shoreline Study, 2001-2002.

	Pre-bait		Post-bait	
	2001	2002	2001	2002
Trap nights	1,448 <sup>a</sup>	980	684	731
Unique raccoons	101	58	32	75
Recaptured raccoons	85	78	16	32
Total raccoons	186	136	48	107
Trap success <sup>b</sup>	7.0%	5.9%	4.7%	10.3%

<sup>a</sup>includes Hammond Density Study

<sup>b</sup>unique raccoons

In addition to comparing raccoon pre-bait and post-bait drop serology levels, radio telemetry tracking was used to monitor seasonal movement patterns. Thirteen adult raccoons (6 males, 7 females) were live trapped, sampled for pre-bait drop serology level testing and fitted with radio collars (Advanced Telemetry Systems, Isanti, Minnesota, USA) in July 2002. Raccoons were tracked 2-4 times per night, for 4 nights a week beginning from 29 July-13 September 2002. Tracking began shortly after sunset and continued until shortly before dawn. All animals were located approximately 50 times over the 6 week period, beginning 4 weeks prior to the bait drop to 2 weeks post bait drop. Data collected from this study will determine if raccoon movements bring them into contact with aerially distributed baits.

Aerial bait distribution took place over the study area beginning 27 August 2002. Post-bait drop surveillance trapping began on 24 September 2002. Seven hundred and thirty-one trap nights yielded 75 unique raccoons. Additionally, 9 of 13 collared raccoons were recaptured and sampled for post-bait drop serology testing. Information collected will be used to identify the percentage of the raccoon population in the study area with detectable levels of rabies virus neutralizing antibodies.

The results of this study may have broader applicability to national ORV projects given the potential common problem of distributing baits close to shorelines because of dwelling and human activity.

### **Other Rabies Control Activities**

For the fourth consecutive year, WS provided cooperative assistance to the New York State Department of Health, which has led an ORV program in the Champlain Valley portion of Essex County, New York for several years. Wildlife Services provided manpower for 441 trap nights and captured a 24 raccoons for biological sampling.

### **Non-target Animals Captured**

Non-target animals captured and released during 2002 included: 1 turtle (species unknown), 59 striped skunks (*Mephitis mephitis*), 2 ruffed grouse (*Bonasa umbellus*), 5 fisher (*Martes pennanti*), and 3 opossum (*Didelphis virginiana*).

### **SUMMARY**

The summer of 2002 marked the fifth year of WS cooperative participation in the St. Lawrence Region ORV project. This project is part of a larger Northeastern ORV effort that includes Vermont, New Hampshire, Maine, and Ontario, Canada, that is in turn, tied to the National ORV program to contain the raccoon strain of rabies and explore strategies to eliminate this unique variant of the rabies virus.

To date, over 2.9 million Raboral V-RG® baits have been distributed across the St. Lawrence Region, encompassing 12,618 km<sup>2</sup>. Since the program was initiated in 1998, a noted decline in positive rabies cases has been recognized. Almost 150 confirmed wildlife rabies cases were reported in 1998 and again in 1999 in St. Lawrence County. In 2002, there were 4 rabies cases, only one of which was attributed to a raccoon.

# WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM OHIO 2002

## BACKGROUND

The presence of raccoon (*Procyon lotor*) strain rabies was first documented in Mahoning County, Ohio in 1996. Rabies cases continued to escalate and in April of 1997 an epizootic of raccoon-strain rabies was identified in northeastern Ohio, with 62 positive cases by year's end. With an epizootic occurring and a peak in public interest, an oral rabies vaccination (ORV) program was initiated in Ohio in an attempt to prevent the further westward spread of raccoon-strain rabies. The original ORV bait zone in Ohio included Trumbull, Mahoning, and Columbiana counties and encompassed 1,780 km<sup>2</sup> (688 mi<sup>2</sup>). With increased surveillance, raccoon rabies cases were identified outside the ORV bait zone. Subsequently, in the fall of 1999, the ORV bait zone in Ohio more than tripled in size to include Ashtabula, Trumbull, Mahoning, Columbiana, Carroll, and Jefferson counties and encompassed 6,497 km<sup>2</sup> (2,509 mi<sup>2</sup>). In 2002, the ORV program in Ohio encompassed 8,518 km<sup>2</sup> (3289 miles<sup>2</sup>) and included Ashtabula, Trumbull, Columbiana, Mahoning, Jefferson, Carroll, Harrison, Belmont, and Monroe counties (Figure 1). Ohio's ORV zone is part of what is now referred to as the Appalachian Ridge Barrier (ARB), which uses natural barriers (Ohio River and Lake Erie), supplemented with rabies vaccine bait distribution, to prevent the westward spread of raccoon strain rabies.

The Ohio Department of Health (ODH) is the lead agency for Ohio's ORV program. Wildlife Services (WS) is an active cooperator, providing a major source of cooperative funding and federal wildlife management leadership. Additional cooperators included: Ohio Department of Agriculture (ODA), Ohio Division of Wildlife (ODW), The Center for Disease Control and Prevention (CDC), The Ohio State University (OSU), and local/county health departments.

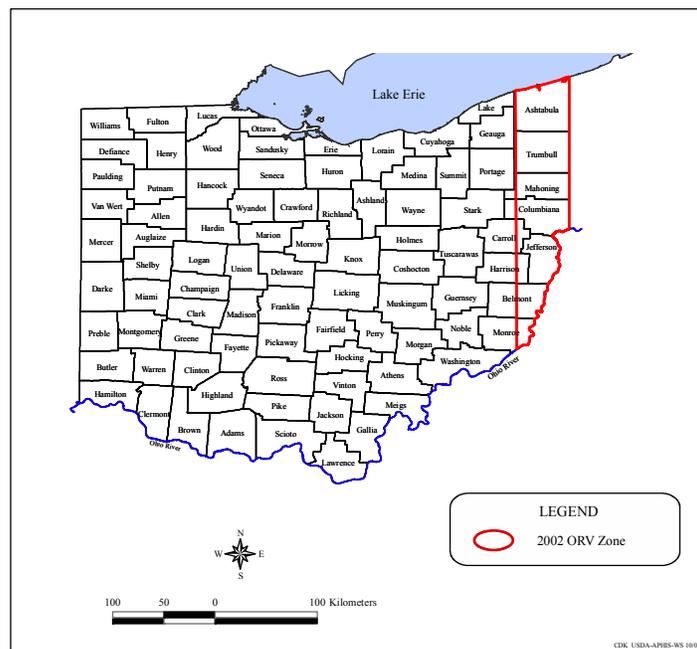


Figure 1. Oral rabies vaccination zone in Ohio, 2002.

## ORV PROGRAM 2002

A single baiting campaign was conducted in Ohio in 2002. The baiting occurred in the fall from 13 August-5 September and included Ashtabula, Trumbull, Mahoning, Columbiana, Jefferson, Carroll, Belmont, Monroe, and Harrison Counties (Figure 1). During the August-September bait drop, 569,090 fishmeal polymer (FP) baits, containing Raboral V-RG® vaccine (MERIAL Limited, Athens, Georgia, USA), were distributed by air, while 60,840 baits were distributed by hand. Total number of FP baits distributed, within the Ohio barrier during 2002 baiting, was 629,930. Baits distributed during 2002 baiting cost \$1.27 each. The FP baits were distributed by air at a rate of 75 baits/km<sup>2</sup>. Aircraft and flight crew for the 2002 ORV program were provided by the Ontario Ministry of Natural Resources (OMNR). Ground and baiting support were provided by WS, ODH, ODW, ODA, Ohio National Guard, and county/local health departments. In a cost-share effort, the ODH afforded \$1,512,816 toward ORV program activities in 2002. Wildlife Services costs, associated with 2002 ORV program activities, totaled \$1,057,165 (Table 1).

Table 1. Oral rabies vaccination program costs for ODH and WS, 2002.

Item	ODH Cost	WS Cost
FP baits	\$559,135	\$153,619
Aircraft contracts/jet fuel	\$2,010	\$250,167
Local health department grants/contracts	\$236,784	N/A
Rabies lab testing	\$199,169	N/A
Salaries and benefits	\$473,441	\$212,139
ORV operations (education, equipment, travel, utilities etc.)	\$42,277	\$441,240
<b>Total</b>	<b>\$1,512,816</b>	<b>\$1,057,165</b>

## MONITORING, SURVEILLANCE, AND EVALUATION

The goal of the 2002 ORV program was to achieve sufficient levels of rabies immunity in the raccoon populations, to create a barrier, and to prevent the spread of the rabies virus to new uninfected areas. During the summer and fall of 2002, WS participated in 2 trapping campaigns, designed to evaluate and monitor project success. This was accomplished through collection of raccoon biological data; blood serum and tooth samples. On 17 June 2002, WS initiated the summer, pre-ORV raccoon live trapping effort in Mahoning, Jefferson, Harrison, and Belmont counties. Samples were collected from 159 raccoons over 467 trap nights (Table 2). Pre-ORV trapping was conducted in a response to an ODH request for background information about raccoons in areas that have been historically baited within the past 5 years. Data collected will help to determine if raccoon populations are maintaining a level of immunity, beyond the 4-9 week detectable titer/antibody levels. All animals trapped in 2002 were handled according to the American Veterinary Medical Association guidelines.

On 9 September 2002, WS shifted its post-ORV raccoon live trapping to follow the late summer bait drop for the previously twice-baited zones of Jefferson, Belmont, Monroe, and Harrison counties. On 30 October 2002, WS completed the year with post-ORV raccoon live trapping and shipped samples to CDC for antibody testing. Samples were collected from 120 raccoons over 1,129 trap nights, during the post-ORV trapping campaign (Table 2). Non-target

species captured and released included: 2 feral cats (*Felis catus*), 1 striped skunk (*Mephitis mephitis*), 1 muskrat (*Ondatra zebethicus*), and 3 Eastern cottontail rabbits (*Sylvilagus floridanus*). Non-target species captured and euthanized included: 1 feral cat, 17 opossums (*Didelphis virginiana*), and 3 woodchucks (*Marmota monax*). Results for antibody presence were returned by CDC in the winter of 2002 (Table 3). Tooth results for 2002 are still pending.

Table 2. Results of surveillance trapping efforts during summer and fall ORV project seasons in Ohio, 2002.

	Summer, pre-ORV	Fall, post-ORV
Trap nights	467	1,129
Unique raccoons	159	120
Recaptured raccoons	2	0
Total raccoons	161	120
Trap success <sup>a</sup>	34.0%	10.6%
Non-target captures	17	42

<sup>a</sup>unique raccoons

Table 3. Results for serology antibody presence in blood, of pre- and post-ORV trapped raccoons in Ohio, 2002.

	Summer, pre-ORV	Fall, post-ORV
Unique raccoon captures	159	120
Testable blood samples	152	118
# raccoons with positive rabies antibody response	20(13.2%)	11(9.3%)

## 2001 TOOTH RESULT UPDATE

In fall of 2002, WS collected over 500 raccoons and carnivores, harvested by fur trappers, from within the Ohio ORV bait zone. Of those 500 animals, WS sent 200 raccoon canine tooth samples to Dr. David Johnston for tooth cementum analysis. Dr. Johnston analyzed teeth for age; tetracycline positivity, related to age; and tetracycline positivity, related to time of year (summer versus fall baiting). Tetracycline hydrochloride is commonly used as a biological marker (biomarker), to assess bait uptake in ORV programs. This biomarker is incorporated into the vaccine-laden FP baits.

Age structure of the 200 raccoons sampled ranged from young-of-year (<1 year old) to 13 years of age. Age structure of the trapper-harvested sample was relatively old, with only 35% young-of-year raccoons. Mean number of animals found positive, within an age class, ranged from 27% for animals 1 year old, to 80% for animals  $\geq 3$  years old. Fall versus summer positivity data indicated that the acceptance/contact rate of fall baits was twice that of summer baits (Table 4).

Table 4. Number of tetracycline bait lines, counted by summer versus fall trapping, in Ohio, 2002.

Year	Summer	Fall
1997	0	5
1998	9	7
1999	6	23
2000	19	41
2001	37	73
<b>Total</b>	<b>71</b>	<b>149</b>

## **OTHER RABIES CONTROL ACTIVITIES**

Throughout 2002, WS provided assistance to the ODH with raccoon rabies submissions for testing. During the 2002 trapping seasons all raccoons which appeared to have puncture wounds (bite marks), exhibited disorientation, or showed signs of illness were euthanized and submitted for testing. In addition, wildlife that showed signs of sickness were obtained from concerned Ohio residents and submitted to the ODH for rabies testing. Thirteen animals were submitted by Ohio WS in 2002; all animals tested negative for rabies.

Wildlife Services trapped 279 raccoons during 2002 surveillance efforts in Ohio (Table 1). All raccoons that WS captured and released during the 2002 surveillance season were ear-tagged with a unique number. These ear tags contained a phone number and a label which read "reward". Wildlife Service logged 29 ear tag numbers from Ohio residents who collected a \$20 reward during 2002. A reward of \$20 was paid by WS for each set of ear tags submitted. In return, WS gained information on raccoon biology and movements. The majority of animals that were returned by hunters and trappers moved  $\leq 1$  mile from the original site of capture.

In November 2002, WS collected 34 carnivores harvested by fur trappers from within the Ohio ORV bait zone. Carnivores collected included: coyotes (*Canis latrans*), mink (*Mustela vison*), red fox (*Vulpes vulpes*), opossum, and striped skunk. Carnivores harvested by trappers in Ohio were collected for tetracycline biomarker detection in teeth and jawbones. Tooth samples collected in 2002 will help to determine age structures of carnivores and age-specific bait uptake rate for carnivores that come in contact with and compete for FP baits that are being dropped via aircraft to targeting raccoons.

## **SUMMARY**

The spring of 2002 marked the sixth year of WS cooperative participation in the Ohio ORV program. This program is part of a larger ARB ORV effort that includes: West Virginia, Virginia, Tennessee, and Pennsylvania. Ohio is also an integral part of a National ORV program. In 2003, the ARB will extend its boundaries to include a larger part of Pennsylvania, West Virginia, Virginia, and Tennessee. Additional states to be included are portions of Alabama, Georgia, and Maryland.

In 2003, Ohio will continue to participate in the ORV program, in order to prevent the westward spread of raccoon strain rabies, as well as to achieve the goal of eliminating raccoon strain rabies from Ohio. To date 5,412,657 FP baits, have been distributed across eastern Ohio. Since the program was initiated in 1997, there has been a noted decline in reported positive raccoon-strain rabies cases in the ORV baited zone. In 1997, there were 62 cases, which declined to 26 cases in 1998. From November 1999 to October 2001, there were no detected raccoon-strain rabies cases in Ohio.

On 6 November 2001, Ohio had 1 documented case of raccoon strain of rabies, which was located approximately 1 mile from the Ohio-Pennsylvania border. In 2002, 1 cases of raccoon strain of rabies were identified, which also were located  $\leq 1$  mile from the Ohio/Pennsylvania border. Raccoon rabies remains enzootic in Pennsylvania; therefore, it is not surprising that rabies cases occurred near the Ohio-Pennsylvania border. Pennsylvania has joined the ORV effort and has started distributing rabies vaccine baits within its borders; Ohio can look to achieve its ultimate goal of eliminating raccoon-strain rabies from the state. However, these cases are still a reminder that the continuation of the ORV program, supported by

enhanced surveillance, is necessary. This will allow us to contain, reduce, and potentially eliminate raccoon strain of the rabies virus rabies in Ohio and throughout the Eastern United States.

## WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM PENNSYLVANIA 2002

### BACKGROUND

Raccoon (*Procyon lotor*) rabies was first reported in Pennsylvania in 1982. The first documented cases occurred in Bedford, Fulton, and Franklin Counties. Twelve years later raccoon rabies had become enzootic throughout the Commonwealth's 67 counties. Since 1995, >400 wild animals have been positively diagnosed for rabies annually. The first fishmeal polymer baits, containing Raboral V-RG® vaccine (MERIAL Limited, Athens, Georgia, USA) were distributed in Pennsylvania during the fall of 2001. A total of 138,602 baits was hand distributed across 1,875 km<sup>2</sup> within 2 counties, in the northwest corner of the Commonwealth. Pennsylvania expanded its baiting program in 2002 to cover 16,978 km<sup>2</sup> in 12 western counties bordering Ohio and West Virginia (Figure 1). The expanded baiting area in Pennsylvania extends the previous rabies barrier established in Ohio. The Pennsylvania Department of Agriculture (PDA) provided the state leadership for the baiting effort. The United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (WS) provided wildlife management leadership and contributed significant funding.

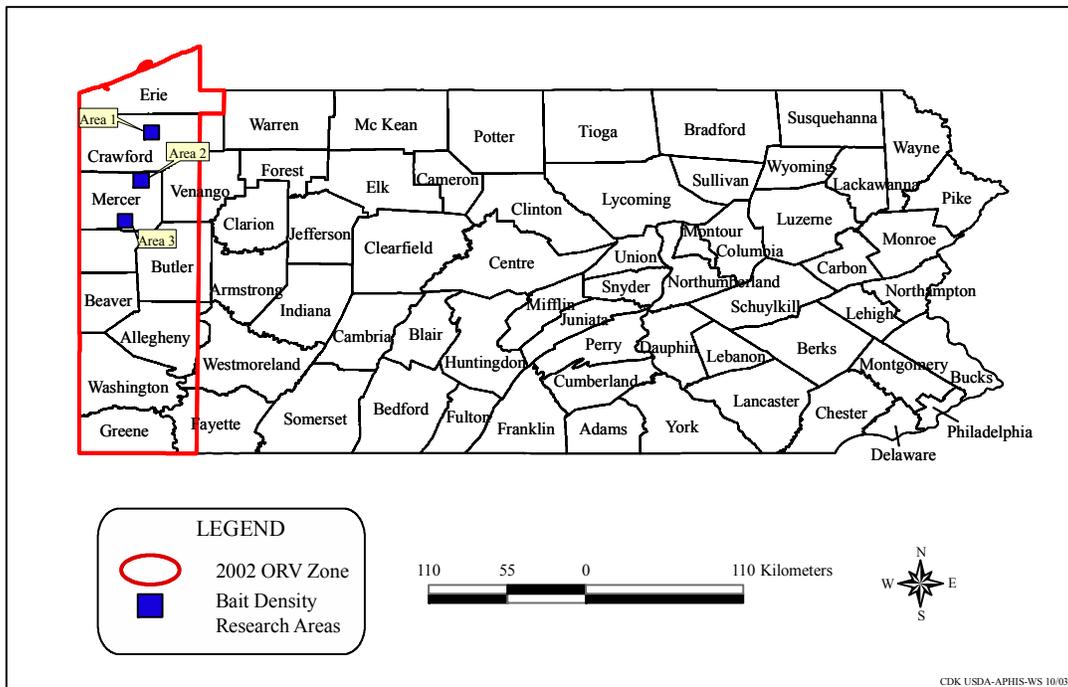


Figure 1. Oral rabies vaccination zone and location of 3 bait density research areas in western Pennsylvania, 2002.

### ORV PROGRAM 2002

Fishmeal polymer baits containing Raboral V-RG® vaccine were used as part of the 2002 ORV program, at a cost of \$1.27/bait. Hand baiting was conducted in large cities and towns throughout 9 counties between 5-14 August 2002, with 248,594 baits distributed. Eight county, state, and Federal agencies assisted with the largest hading baiting effort ever undertaken in the

United States. Agencies included: PDA; Pennsylvania Department of Health (PDOH); Erie County Department of Health (ECDOH); Allegheny Health Department; Pennsylvania Department of Conservation and Natural Resources (DCNR); Centers for Disease Control and Prevention (CDC); APHIS, Veterinary Services, and WS.

Aerial baiting, from fixed wing aircraft, was conducted from 16 August-6 September 2002, with 810,167 baits distributed across 12 counties. In 2 of the 12 counties, 224,760 additional baits were distributed from aircraft, over 3 583 km<sup>2</sup> areas, as part of a bait density research project. The 3 research areas were baited at densities of 300/km<sup>2</sup> (Area 1), 150/km<sup>2</sup> (Area 2), and 75/km<sup>2</sup> (Area 3) (Figure 1). The objective of the research was to determine which baiting density produced the greatest number of positive rabies antibody responses in raccoons.

Aircraft and flight crews for the 2002 ORV program were provided by the Ontario Ministry of Natural Resources. Ground support for the flights was provided by the PDA, Ohio Department of Health, Ohio and Pennsylvania WS. Fiscal Year 2002 spending on rabies activities and research was \$2,335,586.

## MONITORING, SURVEILLANCE, AND EVALUATION

The goal of the ORV program in Pennsylvania is to strengthen the existing ORV barrier in eastern Ohio and to expand this barrier eastward, to reduce the area where raccoon rabies occurs. This cooperative initiative should create a vaccinated area of sufficient size and scope to allow for exploration of ways to eliminate raccoon rabies in the Commonwealth which could be expanded nationally. During the summer and fall of 2002, WS participated in 4 pre-ORV (random and research) trapping projects that were designed to evaluate and monitor the ORV project effectiveness and to collect biological data, such as blood serum and teeth, to determine the rate of bait uptake by raccoons.

Random sites, located throughout the 12 counties, were trapped from 22 June-19 July 2002 and research sites, were trapped from 15-26 July 2002 (Table 1). Each of the 3 583 km<sup>2</sup> research areas contained 3 1 mile<sup>2</sup> research sites, for a total of 9 1 mile<sup>2</sup> research sites. Research protocols were established in cooperation with the WS, National Wildlife Research Center (NWRC), Ft. Collins, Colorado. All animals trapped in 2002 were handled according to the American Veterinary Medical Association's guidelines.

Table 1. Pre-ORV raccoon surveillance trapping on random and research sites in Pennsylvania, 2002.

	Trapping sites	
	Random	Research
Trap nights	224	2,250
Unique raccoons	66	232
Recaptured raccoons	2	21
Total raccoons	68	253
Trap success <sup>a</sup>	29.5%	10.3%
Non-target captures	19	165

<sup>a</sup>unique raccoons

Post-ORV trapping was conducted on the random and research study sites. Random sites were trapped from 15 October-13 December 2002 and research sites were trapped from 16-30 September 2002. Additional trapping within the research areas (Areas 1 and 2) was conducted from 7 October-1 November 2002 (Table 2).

Table 2. Post-ORV raccoon surveillance trapping on random and research sites in Pennsylvania, 2002.

	Trapping sites	
	Random	Research
Trap nights	1,011	3,738
Unique raccoons	123	192
Recaptured raccoons	4	16
Total raccoons	127	208
Trap success <sup>a</sup>	12.2%	5.1%
Non-target captures	101	281

<sup>a</sup>unique raccoons

## Population Monitoring

Raccoon relative density studies were conducted in July and September 2002 on the 3 research areas (9 research sites) described previously (Table 3).

Table 3. Estimated relative density indices (raccoon/km<sup>2</sup>) of raccoon populations on 3 583 km<sup>2</sup> research areas, Pennsylvania, 2002.

Area	County	Density index
1	Crawford	11
2	Mercer	15
3	Mercer	17

## Erie County Ground Bait Study

In 2002, the eastern half of Erie County was hand baited as a continuation of the ground baiting efficacy study begun in 2001. Results from the 2002 study are not available. During 2001, the eastern half of Erie County was hand baited at a density of 75 baits/km<sup>2</sup>. Oral rabies vaccination bait consumption (of at least 1 bait), of trapped raccoons, was indicated by a positive rabies antibody response and/or a positive tetracycline tooth biomarker (Table 4).

Table 4. Results of ground baiting efficacy study, Erie County Pennsylvania, 2001.

Distance (km) to baited road	Number trapped	Number positive for ORV bait consumption
0 to 0.2 km	52	22 (42.3%)
0.3 to 1.0 km	22	9 (40.9%)

Teeth of 20 road-killed raccoons, collected within Erie County, also were tested for the tetracycline biomarker. Ten of the 20 animals (50%) tested positive for the biomarker, indicating consumption of at least 1 ORV bait. However, all animals tested may not have consumed

## Non-target Captures

Five hundred sixty six non-target animals were trapped and released (Table 5).

Table 5. Non-target animal trapped and released, Pennsylvania, 2002.

Species	Number	Species	Number
Bird (species not reported)	1	Eastern cottontail rabbits ( <i>Sylvilagus floridanus</i> )	26
Common grackle ( <i>Quiscalus quiscula</i> )	1	Norway rat ( <i>Rattus norvegicus</i> )	2
Cat ( <i>Felis catus</i> )	58	Squirrel (species not reported)	13
Dog ( <i>Canis familiaris</i> )	1	Striped Skunk ( <i>Mephitis mephitis</i> )	52
Red fox ( <i>Vulpes vulpes</i> )	1	Least weasel ( <i>Mustela nivalis</i> )	1
Muskrat ( <i>Ondatra zibethicus</i> )	1	Woodchuck ( <i>Marmota monax</i> )	97
Opossum ( <i>Didelphis virginiana</i> )	312	<b>Total</b>	<b>566</b>

## OTHER RABIES CONTROL ACTIVITIES

Wildlife Services provided assistance to the Pennsylvania DCNR in efforts to reduce property damage and human health and safety threats associated with raccoons at campsites in Pymatuning State Park in June 2002. Three raccoons were captured during 20 trap nights. Biological data, including blood serum and tooth samples, were collected from each raccoon for evaluation of bait uptake by target species. All animals were submitted to the PDA for rabies testing; all raccoons tested negative for rabies.

In September 2002, 159 raccoons were captured and euthanized in the 9 research sites. Biological data, including blood serum and tooth samples, were collected from each raccoon for evaluation of the effectiveness of the ORV baiting density study. One raccoon tested positive for rabies.

Wildlife Service collected 53 animals (50 raccoons, 3 striped skunks [*Mephitis mephitis*]) within the ORV bait zone, from various road kill surveys, conducted from June-December 2002, and from suspect animals destroyed by Pennsylvania Wildlife Conservation Officers and WS personnel. Four raccoons tested positive for rabies.

## SUMMARY

During 2002, WS completed the second year of cooperative participation in the Pennsylvania ORV program, distributing 1,283,521 ORV baits. Baits were distributed by hand and from aircraft, across 12 counties, encompassing 16,978 km<sup>2</sup>. To date 1,422,123 ORV baits have been distributed in Pennsylvania since baiting began in 2001.

Pennsylvania's baiting effort is part of a larger Appalachian Ridge ORV effort, which in 2002, included Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia. In 2003, the Pennsylvania ORV program continued to distribute baits across the same 12 county area covered in 2002, with expanded coverage including the entire Pittsburgh Metropolitan area. The Erie County ground bait study continued to obtain additional data on bait uptake and sero-conversion by this roadside distribution strategy in largely a rural county.

The Pennsylvania ORV program is an integral part of the larger Appalachian Ridge cooperative effort, which in turn, is tied to national planning efforts to contain the raccoon rabies strain and explore strategies to eliminate this unique variant of the rabies virus.

# WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM TENNESSEE 2002

## BACKGROUND

The Tennessee oral rabies vaccination (ORV) program was launched in 2002 as part of the United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Service (WS) national program to stop the westward spread of the raccoon (*Procyon lotor*) strain rabies. Although the raccoon strain rabies had not been found in Tennessee as of 2002, it was discovered in counties bordering Tennessee in western North Carolina in 1997 and in northern Georgia in 2001. In an effort to stay ahead of the disease front, WS decided to extend the ORV bait area into Tennessee and anchor it in the high elevations of the Appalachian Mountains.

The Tennessee ORV Program is being conducted by the United States Department of Agriculture, Animal and Plant Health Inspection Service, WS in cooperation with the Tennessee Department of Health and the Centers for Disease Control and Prevention. The Tennessee Valley Authority, Holston Army Ammunition Facility, Phipps Bend Industrial Park, and Tennessee Wildlife Resources Agency provided access to private and government owned properties for ORV program trapping and monitoring.

## ORV PROGRAM 2002

The 2002 bait zone covered 4,113 km<sup>2</sup> (1,588 mi<sup>2</sup>) in 7 counties (Figure 1). Fishmeal polymer baits, containing Raboral V-RG® vaccine (MERIAL Limited, Athens, Georgia, USA), were used. Hand baiting resulted in 19,080 baits being distributed in August and 111,414 baits were distributed by air in October. Aircraft and flight crew for the 2002 ORV program were provided by the Ontario Ministry of Natural Resources.

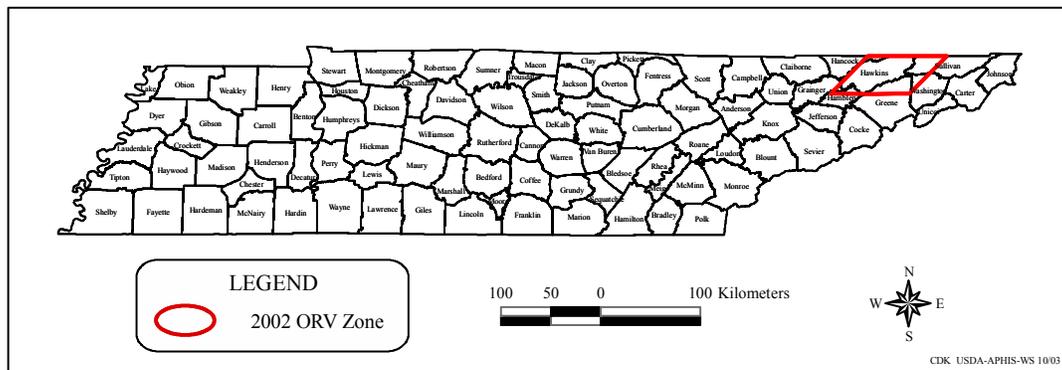


Figure 1. Oral rabies vaccination bait zone in Tennessee, 2002.

## Budget

A total of \$380,342 was expended in Fiscal Year 2002 on the Tennessee portion of the Appalachian Ridge ORV project (Table 1).

Table 1. Expenditures by Tennessee ORV program, Fiscal Year 2002.

Vaccine baits	Aircraft expenses	Personnel (salary/benefits/travel)	Equipment/supplies & services	Total
\$228,600	\$22,675	\$40,010	\$89,057	\$380,342

## MONITORING, SURVEILLANCE, AND EVALUATION

The WS protocol for raccoon population relative density estimates was used to estimate raccoon abundance in Tennessee during July 2002. The area selected for the study was situated at 335 meters in elevation and was typical of a large portion of the state with a mixture of upland hardwood forest, river bottom, and crop fields such as hay and corn. Twenty seven unique raccoons were captured, resulting in an estimated relative density index of 9 raccoons/km<sup>2</sup>.

After the October bait drop, WS conducted post-ORV trapping of raccoons to collect blood and tooth samples and measure program success. During late November and early December 2002, samples were collected from 74 raccoons (Table 2). All animals trapped in 2002 were handled according to the American Veterinary Medical Association guidelines.

Table 2. Post-ORV bait drop raccoon trapping in Tennessee, 2002.

Location	Habitat	Raccoons captured	Positive rabies antibody response	Tetracycline presence
Cherokee Lake	Forested	9	2	0
Holston A.A.P.	Forested	36	3	3
John Sevier	Agricultural	8	1	3
Phipps Bend	Agricultural	14	2	0
Lick Creek	Agricultural	7	0	1
<b>Total</b>		<b>74</b>	<b>8(10.8%)</b>	<b>7(9.5%)</b>

Non-target species that were captured and released during the density study and post-bait drop trapping included: 91 opossums (*Didelphis virginiana*), 8 feral cats (*Felis catus*), 4 Eastern cottontail rabbits (*Sylvilagus floridanus*), 1 striped skunk (*Mephitis mephitis*), 1 gray fox (*Urocyon cinereoargenteus*), 1 box turtle (*Terrapene carolina*), and 1 bobwhite quail (*Colinus virginianus*).

## SUMMARY

In 2002, Tennessee WS became involved in rabies control activities in Tennessee. During the bait drop, 19,080 baits were distributed by hand and 111,414 vaccine baits were distributed by air in portions of seven east Tennessee counties. Post-bait drop monitoring revealed that 8 of 74 raccoons (10.8%) showed a positive rabies antibody response and 7 of 74 raccoons (9.5%) showed positive results for the presence of the tetracycline biomarker.

During 2003, WS will begin to conduct and coordinate active surveillance for raccoon strain rabies in east Tennessee. Additional density study areas and monitoring sites will be secured to look at possible differences in raccoon populations between agricultural, forested, and urban areas.

## **WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM TEXAS 2002**

### **BACKGROUND**

In most years since 1980, more than 90% of reported rabies cases have involved wild animals. Several different strains of the rabies virus are in the United States. Each strain is spread predominantly by one wildlife species, but all strains are capable of infecting warm-blooded mammals, including humans. Raccoons (*Procyon lotor*) and skunks (primarily *Mephitis mephitis*) spread most reported rabies cases in the United States. However, bats, foxes, and coyotes (*Canis latrans*) also have a significant impact as wildlife carriers of rabies.

Two rabies epizootics (epidemics in animals) emerged in Texas in 1988, 1 involving coyotes and dogs (*C. familiaris*) in South Texas and a second involving gray foxes (*Urocyon cinereoargenteus*) in West-Central Texas. The South Texas epizootic resulted in 2 human deaths and >3,000 people received post-exposure rabies treatment. In 1994, the public health threat created by these 2 expanding epizootics prompted the Governor of Texas to declare rabies a state health emergency. The 2 epizootics expanded to involve 69 Texas counties by 1996. In February of 1995, an oral rabies vaccination (ORV) program was initiated. This is a multiyear program with a primary goal of creating zones of vaccinated coyotes and gray foxes along the leading edges of the epizootics, thereby halting the spread of the virus. The ORV program is a cooperative program involving the United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (WS); Texas Department of Health; Texas Wildlife Damage Management Service; Texas National Guard; Centers for Disease Control and Prevention; United States Army Veterinary Laboratory at Ft. Sam Houston, San Antonio, Texas; and other local, state, and federal agencies.

### **ORV PROGRAM 2002**

In January of 2002, WS participated as a member of the ORV program in the aerial distribution of 699,840 ORV baits to prevent the spread of canine rabies in coyotes in South Texas and 1,940,758 ORV baits to contain an outbreak of a rabies strain unique to gray foxes in West-Central Texas (Figure 1). A plastic sachet, containing 2 milliliters of Raboral V-RG® vaccine (MERIAL Limited, Athens, Georgia, USA), was within each bait, composed of fishmeal polymer for coyotes and dog food for gray foxes. During 229 separate flights 31,080 and 55,167 km<sup>2</sup> were baited for coyotes and gray foxes, respectively. Fiscal Year 2002 spending, on rabies activities and research, totaled \$2,510,373.

### **MONITORING, SURVEILLANCE, AND EVALUATION**

Annual evaluations of the ORV program are based on 3 criterion 1 of which is that the baits contain 150 mg of tetracycline used as a biomarker in dental tissue. Detection of that biomarker can be used to demonstrate the number successive days baits are eaten in a given year and the annual bait consumption by animals over a period of multiple years. Evaluations also include determining the serologic response to oral vaccine consumption from within the vaccination zone as well as the epidemiology of rabies strains in the target area.

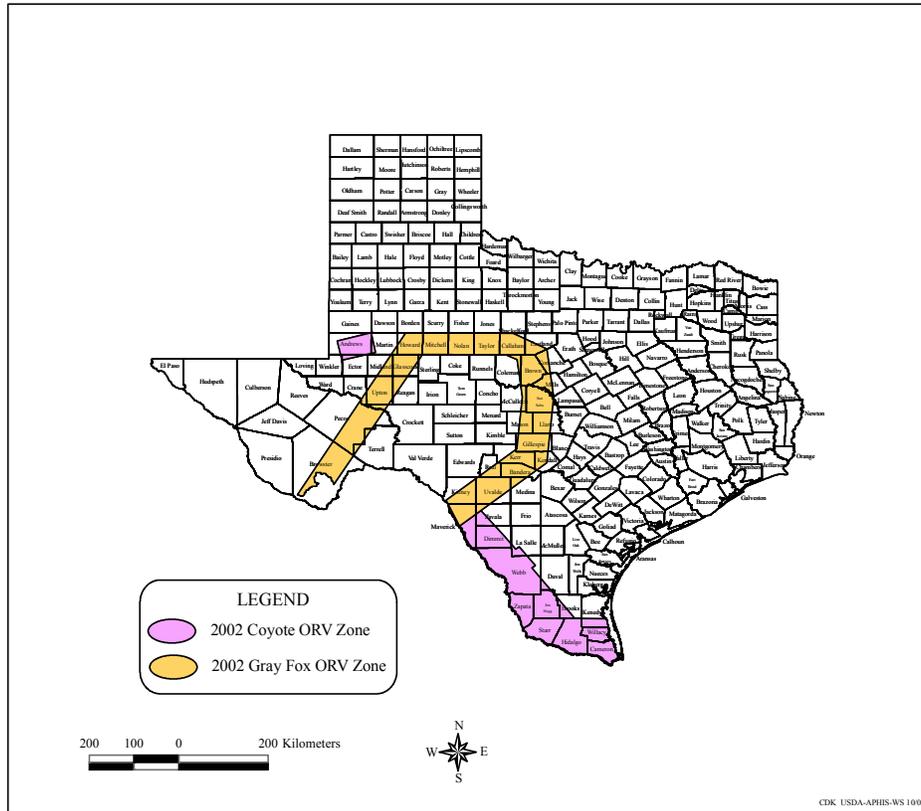


Figure 1. Coyote and gray fox ORV zones in Texas, 2002 (Data provided by Texas Department of Health).

Results from surveillance programs, conducted by WS and the Texas Department of Health in 2002, have shown that 76.6% of the coyotes tested from South Texas were positive for the tetracycline biomarker included in the bait material (Table 1), and 54.8% of the coyotes tested from the surveillance area have shown positive rabies antibody response to the vaccine (Table 2). Canine rabies cases, since the initiation of the ORV program in South Texas, have declined from 166 reported during the pre-program year in 1994 to 94 in 1995, 15 in 1996, 3 in 1997, 7 in 1998, 8 in 1999, 0 in 2000, 1 in 2001, and 0 cases in 2002. All animals trapped in 2002 were handled according to the American Veterinary Medical Association guidelines.

Table 1. Tetracycline results from coyote surveillance efforts in South Texas, 2002.

Species	Positive samples	Negative samples	Total
Coyote	95(76.6%)	29(23.4%)	124

Table 2. Serology results from coyote surveillance efforts in South Texas, 2002.

Species	Positive samples	Negative samples	Total
Coyote	68(54.8%)	56(45.2%)	124

The gray fox program in West-Central Texas has shown similar success, with 188 cases reported in 1995 (pre-program), 57 in 1996, 30 in 1997, 43 in 1998, 74 in 1999, 39 in 2000, and 20 cases in 2001. During 2002, 18 of 65 cases of gray fox rabies reported occurred in Pecos

County. This area is located outside of the western edge of the gray fox vaccination zone. The remaining 47 cases were inside the gray fox vaccination zone. Several factors may have contributed to the breach in the ORV barrier during 2002, including the interruption of the ORV baiting program for 2 consecutive years. During 2000 and 2001 reduced state funding for the ORV program only allowed for the distribution of baits along the eastern edge of the epizootic to protect the state's major metropolitan areas. With restored levels of funding in 2002 and the 1.27 million baits provided by WS, the cooperative ORV program was able to re-establish the western edge of the gray fox vaccination zone. Surveillance results in 2002 showed a positive indication for the tetracycline biomarker in 35% of the gray foxes (Table 3) and a positive rabies antibody response to the vaccine was detected in 52% of the gray foxes tested (Table 4).

Table 3. Tetracycline results from surveillance efforts in West-Central Texas, 2002.

Species	Positive samples	Negative samples	Total
Gray fox	31(35.2%)	57(64.8%)	88
Coyote	15(60.0%)	10(40.0%)	25
Striped skunk	2(16.7%)	10(83.3%)	12
Raccoon	4(50.0%)	4(50.0%)	8

Table 4. Serology results from surveillance efforts in West-Central Texas, 2002.

Species	Positive samples	Negative samples	Total
Gray fox	46(52.3%)	42(47.7%)	88
Coyote	8(34.8%)	15(65.2%)	23
Striped skunk	6(54.5%)	5(45.5%)	11
Raccoon	4(50.0%)	4(50.0%)	8

## SUMMARY

Since 1995, 8.66 million vaccine baits have been distributed over South Texas by the ORV program, which has proved to be highly effective in the elimination of the canine rabies strain in that area. It is believed that the canine rabies virus has been eliminated from Texas. The last case of the virus was reported in Webb County on 15 February 2001. This area of the state is within a few miles of the Mexico border. No additional cases have been reported since this time. A maintenance strategy has been developed, which is designed to maintain a zone of immunized wildlife along the southern Texas border to prevent future re-emergence of the virus from the south. With continued support for the cooperative ORV program effort targeting gray foxes, a similar goal of strain elimination from Texas may be achieved, similar success is sought in the gray fox epizootic in West-Central Texas.

**WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM  
VERMONT 2002**

**BACKGROUND**

Raccoon (*Procyon lotor*) rabies first entered Vermont in 1994. It quickly spread and has been confirmed in all 14 counties in the state. In less than 2 years raccoon rabies had spread through 8 counties in Vermont and by the spring of 1996 was approximately 73 km (45.5 miles) south of the United States-Canada border. In May 1997, an intensive oral rabies vaccination (ORV) program was initiated, with the goal of preventing the northward spread of raccoon rabies. Through aerial and hand-bait distribution, over 1,000,000 fishmeal polymer (FMP) and fishmeal-coated sachet (CS) baits, containing Raboral V-RG® vaccine (MERIAL Limited, Athens, Georgia, USA), have been distributed over northern Vermont since 1997 (Table 1).

Table 1. Oral rabies vaccination program bait distribution in Vermont, 1997-2002.

Year	Area baited km <sup>2</sup>	% of Vermont Baited	Baits distributed		
			FMP <sup>a</sup>	CS <sup>b</sup>	Total
1997	1,637	8.6	72,893	0	72,893
1998	2,193	11.5	116,270	0	116,270
1999	3,501	18.4	189,802	0	189,802
2000	3,558	18.7	198,821	0	198,821
2001	4,110	21.6	34,703	201,555	236,258
2002	6,541	34.4	9,030	332,033	341,063

<sup>a</sup>fish meal polymer

<sup>b</sup>coated sachet

The Vermont ORV program has been a cooperative effort, with Cornell University being the lead cooperator; Wildlife Services (WS) has been the major source of federal funds for project implementation. Wildlife Services also has provided federal wildlife management leadership, by continuing to play an active role in: project planning and coordination, organizing ground support for the bait drop, working in and navigating aircraft to distribute baits, coordinating the hand distribution of baits in areas too populated to bait by air, evaluating if the Green Mountains may serve as a natural barrier to the movement of raccoon rabies, and providing surveillance and follow-up field work, by collecting blood and tooth samples from live-trapped and suspect-rabid animals within the ORV bait zone.

**ORV PROGRAM 2002**

In 2002, the bait zone was expanded to include the city of Burlington and over half of Chittenden County, Vermont's most populated area (Figure 1). During 20 flights, 332,033 CS baits were distributed by Twin Otter fixed-wing aircraft from 23-26 August. Nine thousand thirty FMP baits were distributed by hand from 29 July-3 September. Coated sachet and FMP baits cost \$1.00/bait and \$1.27/bait, respectively. Aircraft and flight crew for the 2002 ORV bait drop were provided by the Ontario Ministry of Natural Resources. Ground and baiting support was also provided by WS, Cornell University, and the Vermont Department of Health.

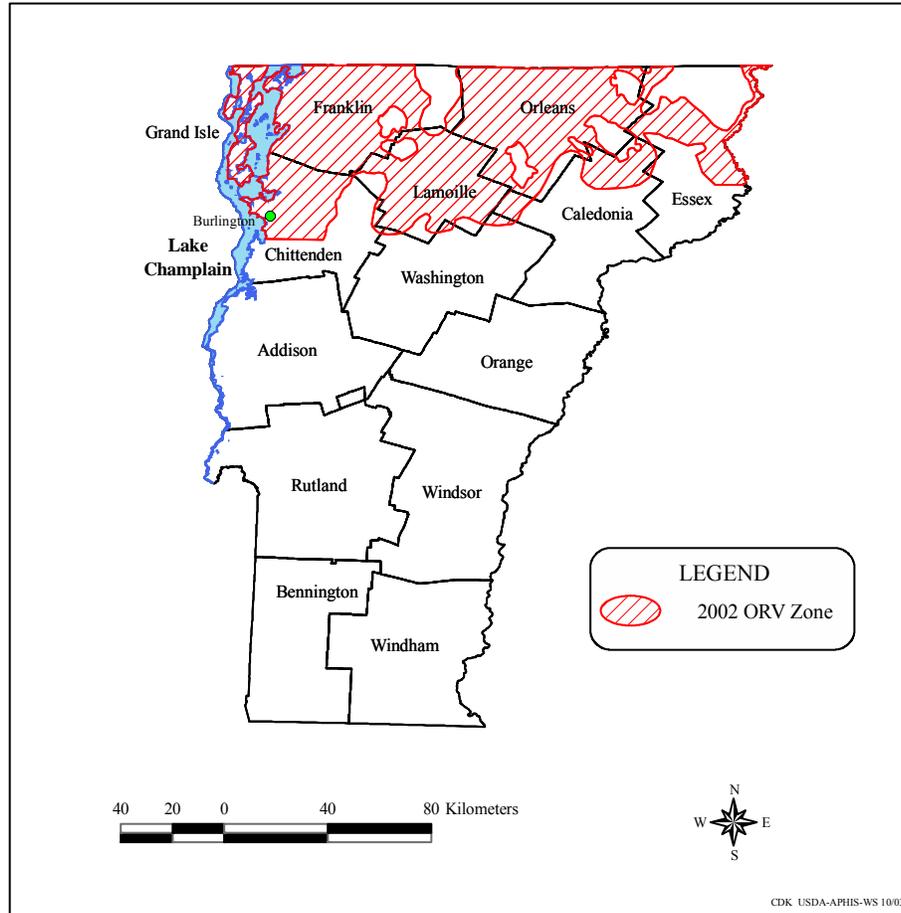


Figure 1. Oral rabies vaccination zone in Vermont, 2002.

## MONITORING, SURVEILLANCE, AND EVALUATION

In an effort to evaluate the efficacy of the ORV program in Vermont, WS collected blood and tooth samples from 341 live-trapped raccoons during the 2002 evaluation phase. Biological samples will be used to assess bait uptake and immune status of the raccoon populations in the ORV zone.

### Population Monitoring

Since 1997, WS has been conducting raccoon relative density studies in Vermont to establish population trends in areas of common agricultural habitat and to determine relative density indices at higher elevations (>500m). Knowing the range of raccoon densities is essential to establishing an optimal ORV strategy for Vermont. On 14 September 2002, WS initiated a replicate of a large-scale raccoon relative density study in the towns of Highgate and Franklin, near the Quebec, Canada border, that was first conducted in September 2001. Relative density estimates were determined on 9 study areas and were conducted using established WS study protocol of 50 traps, over 10 consecutive nights (500 trap nights), on each of the 3-km<sup>2</sup> study areas (Table 2). In cooperation with WS personnel from 5 different states, 244 unique

raccoons were captured on the 9 contiguous cells, representing 27 km<sup>2</sup> (10.4 mi<sup>2</sup>) over 4,500 trap nights (5.4% trap success). This information, along with data from previous years and other states involved in ORV programs, will have broader application in future baiting strategies (Table 2).

Table 2. Estimated relative density indices (raccoon/km<sup>2</sup>) of raccoon populations in Vermont, 1997-2002.

Date	Location	Habitat <sup>a</sup>	Elevation (m)	Density index
September 2002	Highgate - A	1	70	15.0
	Highgate - B	1	75	6.7
	Highgate - C	1	85	7.3
	Highgate - D	1	70	9.0
	Highgate - E	1	75	2.3
	Highgate - F	1	75	10.0
	Highgate - G	1	80	13.3
	Highgate - H	1	95	7.7
	Highgate - I	1	90	10.0
September 2001	Highgate - A	1	70	10.3
	Highgate - B	1	75	6.0
	Highgate - C	1	85	8.7
	Highgate - D	1	70	10.3
	Highgate - E	1	75	7.0
	Highgate - F	1	75	12.7
	Highgate - G	1	80	2.0
	Highgate - H	1	95	5.7
	Highgate - I	1	90	7.7
September 2000	Coventry	1	250	3.0
	Swanton	1	145	3.7
June 2000	Swanton	1	145	4.7
October 1999	Fairfield	1	280	6.3
	Coventry	1	250	9.0
	Sheldon	1	145	5.0
August 1998	Jay Peak	2	730	2.7
August 1997	Sheldon	1	140	6.3
	St. Albans	3	140	9.3

<sup>a</sup>1=agricultural/wooded, 2=forest/high elevation, 3=urban/suburban

Non-target animals captured and released in 2002 included: 5 feral cats (*Felis catus*), 1 dog (*Canis familiaris*), 12 fisher (*Martes pennanti*), 3 ruffed grouse (*Bonasa umbellus*), 1 mink (*Mustela vison*), 3 muskrat (*Ondanta zibethicus*), 1 porcupine (*Erethizon dorsatum*), 1 red squirrel (*Tamiasciurus hudsonicus*), 75 striped skunks (*Mephitis mephitis*), and 2 woodchucks (*Marmota monax*). Non-target animals captured and euthanized included: 1 muskrat, 1 red squirrel, and 1 striped skunk. All animals trapped in 2002 were handled according to the American Veterinary Medical Association guidelines.

## OTHER RABIES CONTROL ACTIVITIES

To enhance protection of the State Threatened, Eastern spiny softshell turtle (*Apalone spinifera*) WS, at the request of the Vermont Fish and Wildlife Department, conducted raccoon removal activities in North Hero State Park, North Hero, Vermont during the summers of 2000-2002 and in Mud Creek Wildlife Management Area (WMA), Alburg, Vermont in 2002. To reduce raccoon egg predation on nesting turtles, WS trapped and euthanized 8 raccoons from the park and 18 raccoons from the WMA, over a combined 167 trap nights (Table 3).

Table 3. Raccoons removed from State-owned land, to protect the State Threatened, Eastern spiny softshell turtle in Vermont, 2000-2002.

	North Hero State Park			Mud Creek WMA
	2000	2001	2002	2002
Raccoons removed	16	6	8	18
Trap nights	36	48	60	107

## SUMMARY

The summer of 2002 marked the sixth year of WS cooperative participation in the Vermont ORV program. Over those 6 years, the Vermont Department of Health has confirmed 478 cases of the raccoon strain of rabies in Vermont, with only 18 (3.7%) of those cases occurring inside the ORV bait zone. Based on the annual spread rate of about 30 miles/year, raccoon rabies was expected to have crossed the Vermont-Quebec, Canada border by 1999. However, this has been prevented by the distribution of 1,155,107 Raboral V-RG® baits over northern Vermont since 1997.

Vermont WS cooperated with New Hampshire WS to coordinate ORV baiting and trapping efforts along the Connecticut River Valley in northern New Hampshire during the 2002 field season. The Vermont and New Hampshire programs are an integral part of a larger Northeastern cooperative effort (that in 2002 included New York, Maine, and Quebec and Ontario, Canada), which in turn, is tied to national planning efforts to contain the raccoon strain and explore strategies to eliminate this unique variant of the rabies virus.

## **WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM VIRGINIA 2002**

### **BACKGROUND**

The United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (WS) program is conducting an oral rabies vaccination (ORV) program to control raccoon rabies in Virginia. The ORV program in Virginia is part of a nationwide, cooperative effort to stop the westward spread of the raccoon (*Procyon lotor*) variant of rabies in the eastern United States.

Raccoon rabies was first introduced to the mid-Atlantic region of the United States, with the translocation of infected raccoons from Florida to Hardy County, West Virginia and Shenandoah County, Virginia in 1978 and 1979. From these counties, the disease spread rapidly along the east coast and has now become enzootic in all of the East Coast states, as well as Alabama, Pennsylvania, Vermont, West Virginia, and easternmost Ohio.

In Virginia, raccoon rabies occurs throughout the state, with the exception of the 4 counties (Buchanan, Dickenson, Lee, and Wise) on the southwestern border with Kentucky. According to the Virginia Department of Health, Office of Epidemiology, infected raccoons accounted for 317 (53.6%) of the 591 animal rabies cases reported in Virginia in 2002. During the past 4 years, January 1999 through December 2002, raccoons have accounted for 1,287 (57.3%) of the 2,248 laboratory confirmed cases of animal rabies statewide. Wildlife Services is working in cooperation with the Virginia Department of Health, the Virginia Department of Game and Inland Fisheries, and local animal control officers to provide as many surveillance specimens as possible.

During Fiscal Year 2002, \$746,643 was disbursed for the ORV program in Virginia; \$509,778, baits; \$57,019, aircraft contract and fuel; \$106,469, salaries; and \$73,37, other (travel, equipment, services, etc.).

### **ORV PROGRAM 2002**

#### **Bait Distribution**

*Hand Baiting.*--On 27-28 August 2002, WS distributed 11,880 fishmeal polymer baits, containing Raboral V-RG® vaccine (MERIAL Limited, Athens, Georgia, USA). Baits were distributed by hand from vehicles in many of the urban and suburban areas of southwest Virginia (Castlewood, Clinchco, Clintwood, Coeburn, Gate City, Grundy, Haysi, Honaker, Lebanon, Norton, Wise, St. Paul, and Weber City) that were within the bait distribution zone. These areas were too densely developed for aerial bait distribution. A total of 1,160 baits were distributed by hand in urban and suburban areas within Buchanan County; 1,080 in Dickenson County; 5,770 in Russell County; 1,170 in Scott County; and 2,700 in Wise County (Figure 1.). In November 2002, an additional 28,080 ORV baits were distributed by hand throughout the bait zone.

*Aerial Baiting.*--Aerial distribution of ORV baits occurred throughout the vaccination zone from 14-28 October 2002. Baits were distributed from low-flying, fixed-wing aircraft at a density of 75 baits/km<sup>2</sup>, along flight lines spaced approximately 500 meters apart. Aerial baiting efforts in southwest Virginia required 67 flight hours to cover the 13,324 km flown across the 6,405 km<sup>2</sup> area included in the aerial ORV distribution area. Baits dropped in southwest Virginia

during the aerial portion of bait distribution totaled 393,451. All or part of the cities and counties, with their respective areas and aerial bait totals, were included in the bait drop area (Table 1).

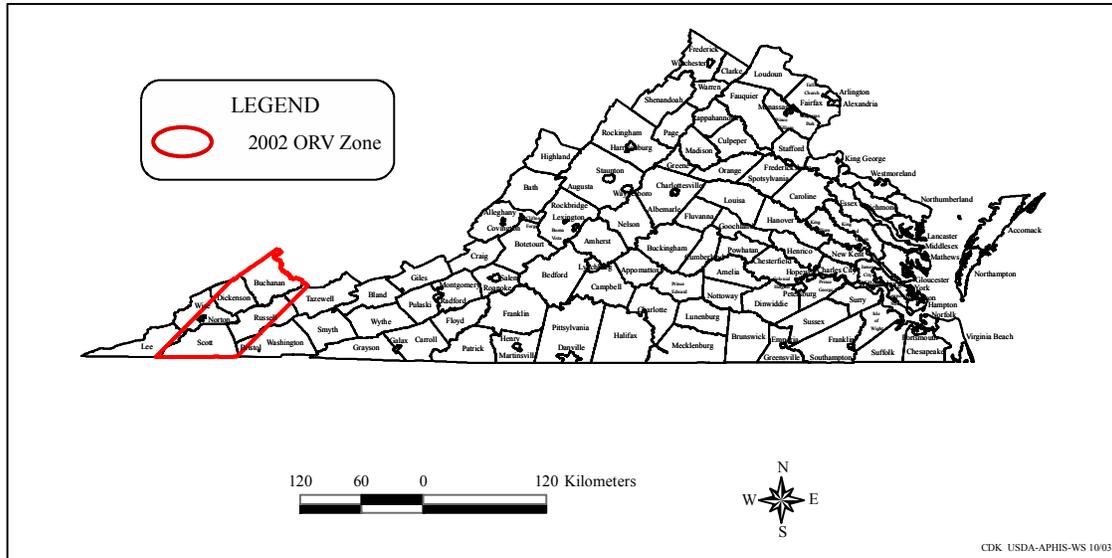


Figure 1. Oral rabies vaccination aerial bait distribution zone in southwestern Virginia, 2002.

Table 1. Oral rabies vaccination aerial bait distribution in southwest Virginia, 2002.

County	Area ( km <sup>2</sup> )	Number baits distributed
Bristol	13.11	805
Buchanan	1,335.61	82,045
Dickenson	706.70	43,412
Lee	88.66	5,446
Norton	3.32	204
Russell	1,173.71	72,100
Scott	1,395.85	85,746
Smyth	22.90	1,406
Tazewell	562.78	34,571
Washington	672.67	41,322
Wise	429.68	26,395
<b>Total</b>	<b>6,404.99</b>	<b>393,451</b>

## MONITORING, SURVEILLANCE, AND EVALUATION

### Population Monitoring

Standard WS protocol was used to estimate the abundance of raccoons on 2 sites in southwest Virginia during July and August 2002. Five Hundred trap nights in the forested macro-habitat of Jefferson National Forest, in Wise County, resulted in the capture of 11 unique raccoons. A relative density index calculation, using the study area size of 2.6 km<sup>2</sup> and the number of individual raccoons captured, resulted in an estimated relative density of 4

raccoons/km<sup>2</sup> (Table 2). An additional 500 trap nights in the agricultural macro-habitat resulted in the capture of 18 unique raccoons. A relative density index calculation, using the study area size of 2.6 km<sup>2</sup> and the number of individual raccoons captured, resulted in an estimated relative density of 7 raccoons/km<sup>2</sup> (Table 2). Thirty one non-target animals were captured, including: 2 woodchuck (*Marmota monax*), of which 1 was euthanized; 22 opossums (*Didelphis virginiana*); 3 Eastern cottontail rabbits (*Sylvilagus floridanus*); 2 striped skunks (*Mephitis mephitis*); 1 gray squirrel (*Sciurus carolinensis*); and 1 woodrat (*Neotoma albigula*). All animals trapped in 2002 were handled according to the American Veterinary Medical Association guidelines.

Table 2. Estimated relative density indices (raccoon/km<sup>2</sup>) of raccoon populations in Virginia, 2001-2002.

Year	Location	Habitat type	Elevation (m)	Density index
2001	Tazewell County	Forested	730-850	5
2001	Tazewell County	Agriculture	700-800	7
2002	Wise County	Forested	850-1,100	4
2002	Russell County	Agriculture	530-640	7

In the Wise County forested study area trap success for unique raccoons, over 500 trap nights, was 2.2%, while overall trap success (including recaptures and non-targets) was 4.8%. In the Russell County agricultural study area trap success for unique raccoons, over 500 trap nights, was 3.6%, while overall trap success (including recaptures and non-targets) was 9.6%.

### Surveillance and Evaluation

Five weeks after completion of the aerial distribution of baits, WS began trapping raccoons within the baited area to collect blood and tooth samples. This post-baiting trapping project was conducted to collect data which will allow WS to evaluate the effectiveness of the ORV program. Blood serum samples, taken from raccoons within the baited area, were analyzed for the presence of antibodies against the rabies virus. Tooth samples are being analyzed for the presence of the tetracycline biomarker, which would indicate bait consumption. These data can be used to determine the percentage of the estimated raccoon population within the baited area that ingested ORV baits and the percentage of raccoons that have a positive rabies antibody response, indicative of successful vaccination.

Raccoons were live-trapped for a total of 4 weeks between December 2002-January 2003. To ensure that the animals captured would have had access to the ORV baits, traps were set at a minimum of 5 miles from either edge of the bait distribution zone. Traps were set on private and public lands in Buchanan, Dickenson, Russell, Scott, and Wise Counties.

Surveillance trapping efforts resulted in a total of 1,863 trap nights and the capture of 75 unique raccoons as well as 5 recaptures (Table 3). Trap success for unique raccoons was 4.1%. Trap success for all raccoons was 4.3%. One hundred sixty five non-target animals were captured during this time, they included: 133 opossums, of which 30 were euthanized and 2 were found deceased in their traps; 21 feral cats (*Felus catus*), of which 6 were euthanized; 3 dogs (*Canis familiaris*); 5 striped skunks, of which 1 was euthanized; 2 Eastern cottontail rabbits; and 1 gray fox (*Urocyon cinereoargenteus*). Overall trap success (inclusive of non-target captures and re-captured raccoons) was 13.2%.

Table 3. Raccoon ORV surveillance trapping in 5 southwest Virginia counties, December 2002-January 2003.

County	Trap nights	Raccoons captured	Samples collected	Positive rabies antibody response
Buchanan	196	5	5	1
Dickenson	230	13	12	1
Russell	450	20	19	4
Scott	613	22	20	8
Wise	374	15	15	3
<b>Total</b>	<b>1,863</b>	<b>75</b>	<b>71</b>	<b>17 (23.9%)</b>

*2002 Serology Results.*--Results from serology tests on blood samples collected from surveillance trapping efforts conducted in December 2002-January 2003 to measure the success of the ORV bait distribution, indicated that 23.9% (17 of 71 samples) of the individual raccoons had a positive rabies antibody response (Table 3). Results from the screening of teeth for the presence of tetracycline are not available at this time.

## SUMMARY

The density studies conducted in the summer of 2002 marked the second year of Virginia's involvement in the Appalachian Ridge ORV project. Approximately 433,000 ORV baits were distributed over 6,620 km<sup>2</sup> in southwestern Virginia during the fall of 2002. In addition, WS conducted rabies surveillance activities in southwestern Virginia to further define the western border of the raccoon rabies distribution in Virginia. Wildlife Services conducted density trapping studies to provide an index of raccoon population densities in the baited area and to provide baseline serology information. Following the bait distribution, WS trapped raccoons to collect serology and biomarker data to assess raccoon population response to ORV. The serology testing indicated a vaccination rate of 23.9%.

Plans for 2003 include: the distribution of ORV baits across approximately the same area as in 2002, to continue conducting density studies for population monitoring purposes, and continued and increased surveillance efforts to monitor the movement of the raccoon variant of rabies in Virginia, and to monitor the success of the ORV bait distribution program.

## **WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM WEST VIRGINIA 2002**

### **BACKGROUND**

The West Virginia oral rabies vaccination (ORV) program was undertaken as part of a nationwide, cooperative effort, to stop the westward spread of the raccoon (*Procyon lotor*) strain rabies. Raccoon strain rabies was first introduced into West Virginia in 1977, from raccoons translocated from southern United States to Hardy County. The virus then spread along the leeward side of the Appalachian Mountains into Pennsylvania, Maryland, and Virginia until it breached the Appalachian Mountain front and began spreading in the cardinal directions through West Virginia. In 2002, 172 confirmed cases of rabies were reported in West Virginia, 125 (72.7%) of which were found in raccoons. Striped skunks (*Mephitis mephitis*) were the second most common species infected with rabies in 2002, with 24 (14.0%) cases confirmed.

The West Virginia ORV program is coordinated by the West Virginia Department of Agriculture (DOA), while surveillance is was conducted by the West Virginia Department of Health and Human Resources (DHHR) and county Departments of Health. The United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (WS) in West Virginia provided funding and operational support, including coordinating bait drops, raccoon population monitoring, and assessing program progress through our live trapping efforts. The West Virginia Division of Natural Resources (DNR) provided permits for handling wildlife, access to state owned property, and expertise in raccoon ecology and management.

### **ORV PROGRAM 2002**

The 2002 ORV bait zone covered 27,319 km<sup>2</sup> (10,548 mi<sup>2</sup>) (Figure 1). During the September-October bait drop, 1,577,758 fishmeal polymer baits, containing Raboral V-RG® vaccine (MERIAL Limited, Athens, Georgia, USA), were distributed by air, while 28,080 baits were distributed by hand. Aircraft and flight crew for the 2002 ORV program were provided by the Ontario Ministry of Natural Resources (OMNR). Ground support was provided by WS personnel from West Virginia, Virginia, Tennessee, Kentucky, Ohio, and Pennsylvania, as well as the West Virginia DHHR, DOA, and DNR, the Ohio National Guard, and the Ohio Department of Health. West Virginia's WS program currently has 4 full-time employees working on the rabies project. Six additional employees assisted during the bait drop and post-bait drop trapping. Fiscal Year 2002 spending, on rabies activities, totaled \$2,824,188.

### **MONITORING, SURVEILLANCE, AND EVALUATION**

#### **Population Monitoring**

Wildlife Services protocol for population relative density estimates was used to estimate abundance in 6 areas within West Virginia during the summer of 2002, including 3 areas trapped during 2001 (Table 1). Two areas were wildlife management areas, managed by the West Virginia DNR and were representative of habitat found throughout much of the state, with forested rolling hills and permanent streams. The other 2 areas were agricultural areas, composed of forest, pasture, and corn fields. In 2002, relative density estimates were lower than

those collected in 2001 (Table 1). All animals trapped in 2002 were handled according to the American Veterinary Medical Association guidelines.

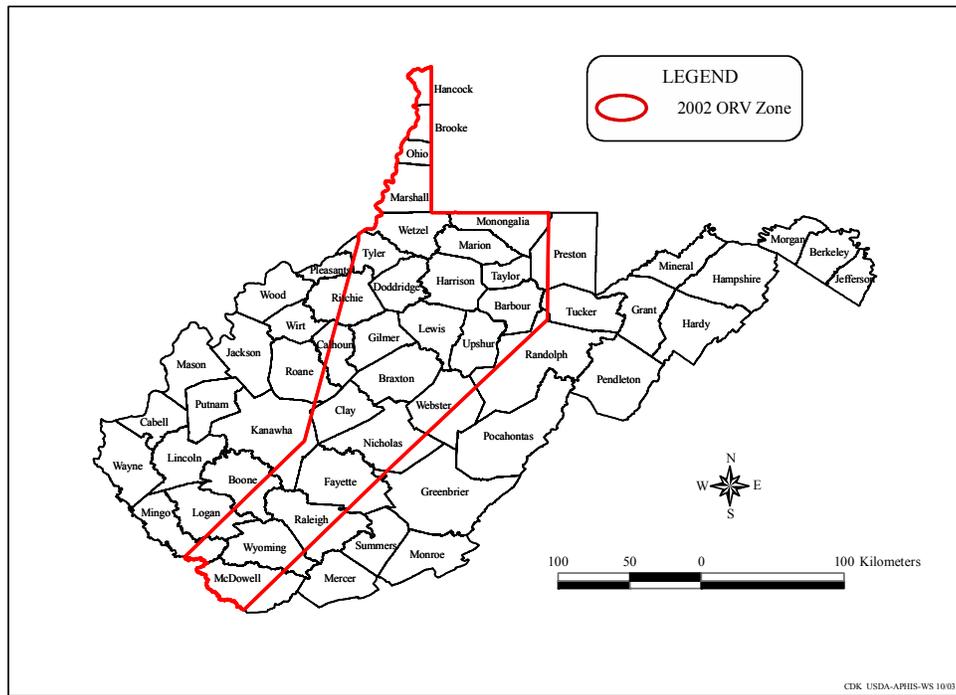


Figure 1. Oral rabies vaccination bait zone in West Virginia, 2002.

Table 1. Estimated relative density indices (raccoon/km<sup>2</sup>) of raccoon populations in select counties, West Virginia, 2002.

County	Habitat	Elevation (m)	Density index	
			2001	2002
Jackson	Agriculture	300	16.2	NA
Clay	Forested	300	8.9	6.6
Wetzel	Forested	300	16.6	7.3
Braxton	Agriculture	550	13.1	6.6
Lewis	Forested	NA	NA	7.7
Nicholas	Forested	NA	NA	5.8
Barbour	Agriculture	NA	NA	12.3

### Surveillance and Evaluation

Following the September-October bait drop WS live-trapped raccoons to collect blood and tooth samples to measure program success. During the months of September and October, 70 unique raccoons were trapped and biological samples collected (Table 2). Of the 70 raccoons tested, 23 (32.9%) were returned with a positive rabies antibody response, indicative of immune activity. Trapping success was low during this time of year due primarily to the abundant fall mast drop, which caused raccoons to disperse.

Table 2. Post-bait drop trapping results in West Virginia, 2002.

County	Unique raccoons captured	Positive rabies antibody response
Ohio	8	2
Nicholas	4	1
Wetzel	15	6
Clay	11	4
Tyler	2	0
Lewis	3	2
Barbour	5	2
Harrison	2	1
Monongalia	15	3
Randolph	2	2
Braxton	2	0
<b>Total</b>	<b>70</b>	<b>23(32.9%)</b>

Non-target species captured and released unharmed included: 37 opossum (*Didelphis virginiana*), 2 beaver (*Castor canadensis*), 2 striped skunks, 9 Eastern cottontail rabbits (*Sylvilagus floridanus*), and 10 woodchucks (*Marmota monax*). Non-target species captured and euthanized included: 3 striped skunks, 1 Eastern cottontail rabbit, and 2 woodchucks.

### Other Activities

During 2002, WS began collecting habitat data to help determine impacts of habitat composition and elevation on estimated raccoon relative abundance (Table 3). An 8.02 m (26.3 ft) diameter plot was sampled at each trap site, with the trap being the center of the plot. Habitat characteristics are important variables that need further research, because the historical spread of rabies through West Virginia appeared to be slowed by the higher elevations of the Appalachian Mountains. Results are pending on data collected in 2002.

### SUMMARY

In 2001, West Virginia became involved in the nationwide ORV program, as a key state in the establishing a national barrier to prevent the westward spread of raccoon rabies. During the bait drop, which began on 13 August 2002, 1,577,758 baits were distributed by air and 28,080 were distributed by hand. Post-bait drop monitoring revealed 23 (32.9%) of 70 raccoons captured had a positive rabies antibody response.

In 2003, bait zone in West Virginia will be expanded to 25,425 km<sup>2</sup> (9817 mi<sup>2</sup>); 1,904,450 baits are scheduled to be dropped. Also during 2003, West Virginia WS will expand its investigation of the influence of elevation and habitat on raccoon population densities, by continuing to collect pertinent habitat data at each trap location. Trapping effort will also be expanded during post-bait drop monitoring to increase sample size.

Table 3. Mean habitat characteristics calculated at successful and unsuccessful raccoon capture sites in West Virginia, 2002.

<b>Habitat characteristics</b>	<b>Successful</b>	<b>Unsuccessful</b>
Basal area <sup>a</sup>	3.23	4.15
Trees >11 diameter at breast height (dbh)	2.48	2.60
Trees <11 dbh	13.10	13.37
Ground vegetation cover (%)	63.24	61.66
Canopy cover (%)	53.54	61.41
Distance (m) to water -intermittent	23.28	32.28
Distance (m) to water- permanent	38.13	53.51
% slope	8.16	10.77
Elevation (m)	1,251	1,242
<b>Tree/shrub species</b>		
Red oak ( <i>Quercus rubra</i> )	2.17 <sup>b</sup>	2.27
White oak ( <i>Q. alba</i> )	2.06	2.54
Beech ( <i>Fagus grandifolia</i> )	2.92	2.04
Hickory ( <i>Carya spp.</i> )	1.67	2.25
Black walnut ( <i>Juglans nigra</i> )	1.54	1.54
Common apple ( <i>Malus sylvestris</i> )	7.4	1.94
Pear ( <i>Pyrus communis</i> )	1.0	1.0
Black cherry ( <i>Prunus serotina</i> )	2.73	2.77
Flowering dogwood ( <i>Cornus florida</i> )	1.0	2.06
Blackberry ( <i>Rubus spp.</i> )	4.62	6.50
Grape ( <i>Vitis spp.</i> )	2.44	2.24
Autumn olive ( <i>Elaeagnus umbellate</i> )	2.82	3.76

<sup>a</sup>calculated using a 20-factor prism

<sup>b</sup>tree/shrub species per plot

# WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM WYOMING 2002

## BACKGROUND

Until recently Wyoming Wildlife Services (WS) has not played a significant role in rabies control and surveillance in Wyoming due to lack of funding and our ties to provide cooperative services to individual counties on a yearly basis. Cooperative services, for the most part, have been directed toward the management of predators, primarily coyotes (*Canis latrans*), to protect sheep and cattle.

Campbell County, located in the northeast part of the state, has been the location of our most significant rabies program activities to date (Figure 1). In 1996, WS was approached by the Campbell County Commissioners to assist with the skunk rabies problem and to coordinate testing of animals taken in the county. Since 1996, with the success of our efforts, the program has grown into a full-time partnership requiring the services of two full-time specialists. Their roles in the county include predator control, rabies control and assisting with rabies surveillance. Wildlife Service has also been involved in rabies trapping intermittently in other counties, but Campbell County is the only where WS act as the lead agency.

In late 2002, a Wildlife Biologist position was created with emphasis placed on rabies issues and coordination with other State and Federal agencies. In 2002, WS also worked with the Wyoming Animal Damage Management Board (ADMB) to start implementing a statewide wildlife rabies coordination plan. Although the plan was not completed in 2002, significant progress was made.

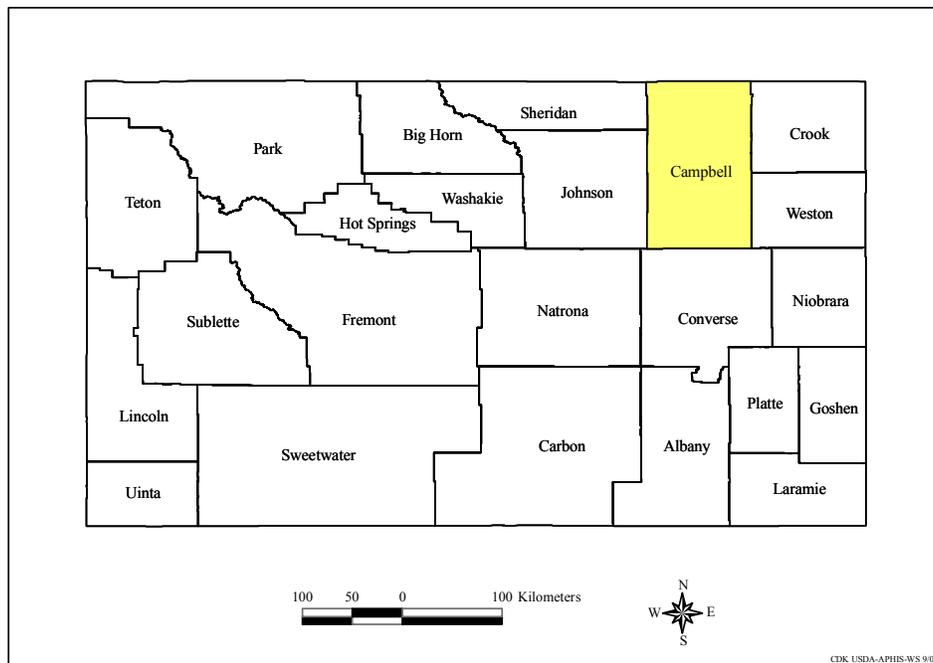


Figure 1. Location of WS rabies-related activities in Campbell County, Wyoming, 2002.

## **ORV PROGRAM 2002**

In 2002, WS participated in a multi-state study, coordinated by WS, National Wildlife Research Center, to test oral rabies vaccination (ORV) bait acceptance by skunks. Activities included acquiring the necessary equipment and coordination, to determine study sites for the project. Fiscal Year 2002 spending on rabies activities and research in Wyoming totaled \$250,357.

## **MONITORING, SURVEILLANCE, AND EVALUATION**

In 2002, WS evaluated historical skunk rabies trends to determine prospective areas to conduct the ORV placebo bait studies. We also participated in surveillance and monitoring work in Campbell County as a part of normal work activities and responding to nuisance complaints received by the WS Specialists located there. All animals trapped in 2002 were handled according to the American Veterinary Medical Association guidelines.

## **SUMMARY**

In 2002, WS rabies activities were focused on the initiation and development of cooperative working agreements with local, state, and federal agencies. Equipment, such as live traps, vehicles, and euthanasia chambers were purchased for work to be completed in counties selected as part of the placebo bait study and for rabies surveillance work. Wildlife Services has coordinated with the Wyoming ADMB in developing rabies protocols for statewide rabies work. Education of WS field staff continues and preparations are being made for the 2003 ORV placebo bait study.

**NATIONAL WILDLIFE RESEARCH CENTER  
CONTROLLING AND MANAGING WILDLIFE VECTORS OF RABIES 2002**

**GOAL**

To study the ecology of wildlife diseases, assess the risk of disease transmission among wildlife, domestic animals, and humans, and develop methods that reduce or eliminate such transmission.

**OBJECTIVES AND PROTOCOLS**

**Objective 1**

Obtain basic information on rabies in wildlife reservoirs and vectors.

Research on the ecology of rabies is currently being developed. Collaborations with Pennsylvania State University and Texas A&M have been developed to study the zoogeography of raccoons (*Procyon lotor*) and striped skunks (*Mephitis mephitis*), respectively, as it relates to the oral rabies vaccination (ORV) program.

Scientists at the National Wildlife Research Center (NWRC) Sandusky Field Station have initiated a study to determine the fate of ORV baits in the environment. The standard oral, vaccinia-vectored, rabies vaccination (ORV) baiting density to target raccoons is 75 baits/km<sup>2</sup>. However, few data are available as to the longevity of baits in the field and their fate relative to a specific raccoon population density. Therefore, the objectives of this study are to (1) estimate raccoon population density on the 22 km<sup>2</sup> NASA Plum Brook Station (PBS) in Erie County, Ohio, during August through October; and (2) evaluate the longevity and fate of ORV baits distributed at 75 baits/km<sup>2</sup>.

Studies on skunk ecology are also being developed in collaboration with Texas A&M University. This collaboration will examine the ecology of skunks in urban/suburban environments in Texas. Data gained from this work will help develop baiting strategies for the ORV program.

*Study Protocols.--*

QA-983 Comparison of bait consumption and vaccination rates of raccoons exposed to 3 densities of Raboral V-RG® rabies vaccine (MERIAL Limited, Athens, Georgia, USA).

QA-965 Fate of ORV bait relative to raccoon density.

*Cooperative Agreements.--*

Pennsylvania State University, Wildlife and Fisheries Science Program – Zoogeography of common raccoons in Western Pennsylvania.

Texas A&M University Kingsville, Caesar Kleberg Wildlife Research Institute – Ecology of urban skunks in Texas.

## Objective 2

Develop methods that decrease transmission of rabies among wildlife, livestock, and humans.

A study has been initiated to determine the most effective bait density for delivering ORV to raccoons. The study will evaluate three bait density treatments (75, 150, and 300 baits/km<sup>2</sup>). Treatment areas will consist of 225 mi<sup>2</sup> zones in northwestern Pennsylvania. Results will provide the ORV program with critical data on the most efficient baiting strategy for raccoons. A multi-state study is being initiated to evaluate potential rabies baits for use in future ORV activities. Currently, no acceptable bait for distribution of a rabies vaccine has been developed. This study will be conducted in Texas, California, Arizona, Wyoming, and Louisiana over the next 12 months.

### *Study Protocols.--*

QA-983 Comparison of bait consumption and vaccination rates of raccoons exposed to 3 densities of Raboral V-RG® rabies vaccine.

QA-998 Efficacy of ORV relative to bait density and raccoon population density.

QA-1040 Acceptance of placebo rabies baits by skunks.

## Objective 3

Develop a method to evaluate the effectiveness of management practices on reducing the prevalence of diseases in wildlife

A cost-savings model of oral vaccination for raccoon-variant rabies is being developed. This model will consider that pre-epizootic medical, veterinary, legal, and insurance costs produced by the combined effects of bat-(Order *Chiroptera*), fox- (*Urocyon cinereoargenteus*), coyote-(*Canis latrans*), raccoon-, and skunk-variant rabies. During a rabies outbreak, these costs “spike.” The local or regional savings offered by an ORV program is the relative difference between baseline and epizootic costs, minus those charges linked with ORV. This cost difference between pre-epizootic and epizootic rabies for total pet vaccinations, livestock vaccinations, pet replacements, livestock replacements, suspected rabid-animal quarantines, public health activities, human pre-exposure vaccinations, human post-exposure treatments, and human deaths form the maximum savings that can result from ORV. Several studies to estimate costs of specific elements in the model are underway (e.g., quarantine charges, human post-exposure prophylaxis treatments).

In September 2002, a Cooperative Agreement was set up between the California Department of Public Health and the Animal and Plant Health Inspection Service for research of direct and indirect benefit-cost effects linked to skunk rabies in that state. These data will quantify direct and indirect costs of post-exposure rabies prophylaxis (PEP), public health, and animal control expenses linked to rabies in Santa Barbara and San Luis Obispo Counties.

*Study Protocols.--*

QA-802 Spreadsheet development to estimate economic indices of wildlife damage intervention (QA-802).

QA-816 Post-exposure prophylaxis cost analysis of skunk rabies cases in Santa Barbara and San Luis Obispo Counties, California.